Saskatchewan Environment

Water Pollution
Control Branch

North Saskatchewan River Water Quality 1970 - 1982 Summary Report

October 1984
WPC 41

NORTH SASKATCHEWAN RIVER
WATER QUALITY 1970-1982
SUMMARY REPORT

Water Pollution Control Branch
Saskatchewan Environment

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ABBREVIATIONS

BOD	Biochemical oxygen demand (5-day)
cm	Centimetre
DOC	Dissolved organic carbon
^oC	Degrees centigrade
FC	Fecal coliforms
FS	Fecal streptococci
h	Hour(s)
Km	Kilometres
MF	Membrane filtration
m^3	Cubic metres
m^3/sec	Cubic metres per second
meq/L	milliequivalents per litre

ABBREVIATIONS (continued)

uS	Micro Siemens/cm
mg/L	Milligrams per litre
ml	Millilitres
MPN	Most probable number
NTU	Nephelometric turbidity units
PCP	Pentachlorophenol
PPWB	Prairie Provinces Water Board
PAPCO	Prince Albert Pulp Company
SAR	Sodium adsorption ratio
SSWQ OBJ	Saskatchewan surface water quality objective
SDWQ OBJ	Saskatchewan drinking water quality objective
TC	Total coliforms
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids

SUMMARY

A comprehensive water quality study of the North Saskatchewan River was initiated in 1981 by the Water Pollution Control Branch. The main objectives of the study were:

1. to establish baseline water quality which would be useful for characterizing the river as a multiple-use resource;
2. to identify areas requiring further site-specific water quality investigations;
3. to identify water users along the river;
4. to review historical data and the results of intensive monitoring conducted in 1981 to 1982 with respect to existing water usage and Saskatchewan surface water quality objectives.

The North Saskatchewan River basin within Saskatchewan has approximately 150,000 residents. As of late 1984, there were 65 licensed water use sites involving withdrawal of river water for domestic, municipal, industrial and irrigational purposes and the discharge of treated wastewater and storm water. The major water users included the Cities of Lloydminster, North Battleford and Prince Albert and the Prince Albert Pulp Company. Other uses include unlicensed domestic supplies, livestock watering, ferry transportation, fishing, camping, and canoeing. Contact recreational use (e.g. bathing) of the river is not important at present. Possible future development of hydroelectric producing reservoirs may increase the potential for contact and noncontact recreational usage of the river.

Water quality data concerning 51 selected variables obtained since 1970 from 12 provincial surface water quality network monitoring sites were retrieved and summarized using the ESQUADAT computer system. This historical data was supplemented by a more intensive monitoring program conducted at these and four additional sites during 1981 and 1982. The data were analyzed to determine apparent trends in river water quality over time and between stations and to assess relationships to seasonal and hydrological (river flow) influences.

The water quality data reviewed in this study indicated that potential water use limitations existed in the river reach downstream of Prince Albert. An intensive water quality investigation was undertaken in the fall, 1983 to address matters related to dissolved oxygen deficiencies and high bacteria levels in this lower reach. The findings of that study are presented in another report (Saskatchewan Environment 1984.)

The results of this water quality data review indicated the following:

1. Dissolved oxygen concentrations and per cent saturation levels generally were satisfactory and showed a trend towards increased minimum levels at most sites between 1981-1982. However, oxygen deficiencies were noted for individual sampling occasions at most locations and were most pronounced under the ice-covered conditions of winter, in the lower reach of the river (e.g. below Prince Albert). Minimum dissolved oxygen levels in the lower reach in 1981-1982, were all above the 5 mg/L surface water quality objective value. This improvement in the winter dissolved

oxygen regime of the river is attributed mainly to improvements in municipal and industrial wastewater treatment implemented in the mid 1970's, and to concurrent increased winter flows stemming from reservoir operations in Alberta. Small dissolved oxygen deficits were measured at several locations in the river during darkness hours in July, 1982.

The concentrations of total organic carbon and biochemical oxygen demand (variables influencing oxygen consumption in water) were higher in the river reach below Prince Albert, compared to upstream sites. However, levels of these variables in the lower river reach have declined since the mid 1970s, presumably in response to improved wastewater treatment at Prince Albert and at the pulp mill.

2. In the lower reach of the river, long-term mean concentrations of total Kjeldahl nitrogen, ammonia, and nitrate-nitrogen were slightly higher and mean concentrations of total phosphorus and ortho phosphorus were slightly lower compared to sites upstream of Prince Albert. These spatial trends were not apparent in the data collected during the 1981-82 intensive survey. Changes in the analytical procedures for total Kjeldahl nitrogen, ammonia and phosphorus introduced in 1976 is believed to be mainly responsible for the lower levels of nitrogen variables and higher levels of total phosphorus recorded for all sites since 1976.

The mean concentrations of nitrogen variables tended to be higher at most stations under the low flow and physical conditions of the winter seasons during the 1970-1982 period. However, the concentrations of ammonia-nitrogen present as unionized ammonia-nitrogen (eg. NH_3-N) were estimated to be greater during the spring/summer periods than in winter. Total phosphorus concentrations were highest during the spring/summer seasons, presumably due to higher river flows and suspended sediment loads. Total Kjeldahl nitrogen and phosphorus concentrations at most sites were consistently near to or in excess of the existing Saskatchewan surface water quality objective maximum values. However, these relatively high nutrient concentrations often occur naturally in prairie rivers.

The estimated higher concentrations of unionized ammonia-nitrogen in the river during the spring/summer periods may be attributable to the effects of naturally higher water temperatures and pH levels in these periods. Generally, the estimated unionized ammonia-nitrogen concentrations in individual samples were less than maximum allowable levels suggested by proposed criteria for the protection of aquatic life. Additional monitoring of levels of ammonia-nitrogen and influencing variables (eg. temperature, pH) during the summer season is recommended.

3. Geometric mean densities of total and fecal coliform bacteria were usually well below the Saskatchewan surface water quality

objectives for recreational, vegetable crop irrigation, and municipal supply uses at sites between the Alberta/Saskatchewan border and Prince Albert.

In the lower river reach, from Cecil Ferry to Cole Rapids, the geometric mean densities of total and fecal coliforms generally exceeded the maximum levels considered acceptable for most water uses addressed in the existing surface water quality objectives. These high densities of indicator bacteria were attributable to municipal sewage and pulp mill effluents. Contact recreational usage of the water in this lower river reach is not believed to be significant at present.

The bacteriological quality in the lower river was further investigated under low flow conditions in the fall, 1983. That study revealed that water quality at the pulp mill intake, on the north shore of the river was not influenced directly by the sewage effluent plume originating from the City of Prince Albert. It also indicated there was a potential for the high bacteria levels attributable to sewage and pulp mill effluents to influence the water quality of the river at locations far downstream of Cole Rapids. The significance of the high fecal coliform levels in areas below the pulp mill effluent outfall is difficult to determine at present since many of the bacteria reported as fecal coliform in the mill effluent are believed to be of non-fecal origin.

4. River pH values were generally within the Saskatchewan surface water quality objective range of 6.5 to 8.5. The pH levels displayed little variation among years or between stations, but were consistently lower during the winter season at all sites. This winter pH depression was presumed due to natural causes involving ice cover, and acidity associated with decomposition by-products and increased carbon dioxide levels in the water.

   Annual mean alkalinity values ranged from 132 to 163 mg/L, indicating a well buffered aquatic system. Alkalinity tended to increase in a downstream direction and a trend towards slightly lower alkalinity levels at most sites over the 1970-1982 period was also observed. Alkalinity levels in winter were higher due to ice formation, and a greater proportion of flow related to ground water infiltration.

5. Conductivity and total dissolved solids concentrations increased in a downstream direction. Values at all sites have decreased slightly over time. Both variables are influenced by seasonal and flow conditions and were observed at higher levels under the low flow conditions of winter. Total dissolved solids concentrations were always well below the maximum desirable concentration of 1,500 mg/L prescribed in the Saskatchewan drinking water quality objectives.

The concentrations of chloride, potassium, sodium, and sulphate increased in a downstream direction. Seasonal mean concentrations of chloride, sodium, magnesium, sulphate and calcium were generally higher at all sites during the winter periods. Mean concentrations of chloride, sodium and sulphate measured during the 1981-1982 intensive study were lower in comparison to values for the 1970-1982 period as a whole. Chloride, sodium, magnesium and sulphate concentrations were well below levels prescribed in the Saskatchewan drinking water quality objectives. Sodium (as per cent of cations) and sodium adsorption ratios increased in a downstream direction. However, the per cent sodium values were all within or below the range listed in the Saskatchewan surface water quality objectives. The sodium adsorption ratios ranged from 0.23 to 1.0 meq/L, indicative of water suitable for application to all soil types and crops.

Mean total hardness at all sites ranged from 154 to 214 mg/L, well under the Saskatchewan drinking water quality objective of 800 mg/L.

6. Mean colour levels in the river ranged from 8.3 to 66 colour units. The highest values were usually observed at the Cecil Ferry north site which was influenced by the brown-coloured pulp mill effluent plume. The influence of the plume on colour was limited to a relatively short reach of river and at Cole Rapids (10 Km downstream), colour had declined to acceptable levels.

Total suspended solids concentrations and turbidity in the river varied greatly between sites, and were highest during the high flow periods of the spring/summer season. Higher turbidity levels in the lower river reach were noted during the 1981-1982 intensive survey. Increased turbidity levels during high flow periods may pose an increased burden on water treatment processes and may interfere with other water uses and aesthetic appreciation of the river. The high suspended solids and turbidity levels in the river during high flows are related mostly to natural causes. During high flow periods, large quantities of nutrients (e.g. phosphorus), metals, and contaminants such as pesticides may be transported as part of the suspended sediment load to lower reaches of the river and to downstream reservoirs.

7. The concentrations of most heavy and trace metals in the river were below the Saskatchewan surface water quality objectives or below levels indicated by other criteria as significant to various water users or water uses. However, mean levels of cadmium, copper and silver at several sites exceeded the objectives. Further investigation to confirm these findings may be warranted. Since these data pertain to total metal concentrations, conventional filtration procedures would be expected to remove most of the amounts present.

   Suspended sediment samples collected under high flow conditions in July, 1981 were analysed for heavy metal content. These preliminary data indicated that heavy metal concentrations associated with suspended sediments were relatively uniform throughout the entire river reach. Metals associated with suspended sediments are generally biologically unavailable, so the direct significance of these data to water quality is uncertain. (Additional study of the heavy metal, as well as nutrient and trace organic content of the suspended sediment in the river under low flow conditions, is currently being conducted by the Inland Waters Directorate of Environment Canada.)

8. Five pesticides were present at detectable concentrations. Trace levels, at or near the detection limit, of 2,4-DP and 2,4,5-T were found on one occasion only. At such minute concentrations these pesticides are considered of no significance to water use. The three other detectable pesticides included 2,4-D, alpha BHC and gamma BHC (lindane), all of which are commonly observed at trace levels in waters of agricultural areas. The concentrations of these pesticides were considerably less than the maximum acceptable levels specified for 2,4-D and lindane in the Saskatchewan drinking water quality objectives. Their presence in surface waters at such low levels is not considered harmful to aquatic life or other users of the river.

9. Mean concentrations of phenolic substances at most stations were below the Saskatchewan surface water quality objective of 0.005 mg/L. At most stations, however, the observed levels in

individual samples frequently exceeded the Saskatchewan drinking water quality objective of 0.002 mg/L, indicating that taste and odour problems associated with phenolics might occur periodically in treated drinking water. The highest concentration of phenolics (.013 mg/L) observed at the Alberta/Saskatchewan border, may relate to industrial sources of phenolic materials (e.g. petrochemical industry effluents) in Alberta.

10. Resin acid concentrations in the river showed considerable variability and no apparent relationship to known effluent sources of this constituent. The highest levels were observed at the Highway 376 site below North Battleford. The mean resin acids concentrations at several sites exceeded the Saskatchewan surface water quality objective. Resin acid levels in the river are most likely of natural origin.

11. Mean sulphide concentrations at 8 locations exceeded the Saskatchewan surface water quality objective of 0.05 mg/L. The highest sulphide levels (range 0.68-3.2 mg/L) were recorded at the Cecil Ferry north, Borden Bridge, Highway 21 and Cole Rapids stations during the spring/summer and fall seasons during 1981-1982. These results indicate a need for further sulphide monitoring and suggest a potential for adverse effects on aquatic biota and for odour problems in water withdrawn from the river for domestic use.

RECOMMENDATIONS

1. It is recommended that a water quality study be carried out to evaluate the dissolved oxygen regime of the lower reach of the river (i.e. below Prince Albert) during the winter under ice-covered conditions.

2. Continued monitoring of the existing provincial water quality network stations should be maintained for variables addressed in this report in order to provide ongoing data needed for future determinations of temporal and spatial trends in levels of various parameters.

3. Some anomalies concerning high nutrient, bacteria, resin acid and heavy metal variables were observed at stations in the river reach immediately above, at and below North Battleford. These anomalies should be further investigated to confirm the findings and to determine the causes.

4. It is recommended that further monitoring of ammonia-nitrogen levels in the river at the Prince Albert water treatment plant intake and the north and south transect stations at Cecil Ferry be undertaken during the summer in order to provide a data base sufficient for determining 30-day average values for unionized-ammonia (in Section 3.1.3.1). This monitoring should include the collection of at least five samples

of water over a 30-day period for ammonia-nitrogen analyses, as well as for variables which may significantly influence the concentration of unionized-ammonia in water (eg. pH, temperature, total dissolved solids). The samples should be analysed immediately or be preserved.

5. Additional monitoring of the river for sulphides should be conducted to determine the reasons for the anomalous results pertaining to sulphide levels in the river during the open water season.

1. INTRODUCTION

1.1 Background

Water quality monitoring of the North Saskatchewan River has been carried out by Saskatchewan Environment for a number of years. Since 1970 periodic grab samples have been obtained from sampling sites which formed part of the provincial surface water quality monitoring network. This routine monitoring provided data needed to assess the quality of river water entering the province from Alberta, and provided information needed to assess the quality of the river water at areas near major municipal and industrial intakes and effluent outfalls. It also provided a historical data base needed to assess long-term trends in the quality of the river water. In order to supplement this data base and to better characterize water use and development impacts on the river a more intensive monitoring program was initiated in 1981 and carried out over a two consecutive year period.

1.2 Scope and Objectives

The basic objectives of the present study were:

1. to establish baseline water quality information useful for characterizing the river water as a multiple-use resource;
2. to identify areas requiring further site-specific water quality studies on the North Saskatchewan River;
3. to identify licensed water users along the river; and
4. to review historical data and 1981-82 data with respect to existing water usage and with respect to Saskatchewan surface water quality objectives.

1.3 Study Setting

The North Saskatchewan River originates from snow and glacial meltwaters in the eastern Rocky Mountains of Alberta. Waters flow through the foothills region on the eastern slopes, and then enter the rolling plains of the Alberta Plateau. The Missouri Couteau escarpment, a discontinuous ridge adjacent to the valley near North Battleford, Saskatchewan, separates the Alberta Plateau from the lower Saskatchewan Rivers Plain near North Battleford (Prairie Provinces Water Board 1982). The river flows through this latter region to its confluence with the South Saskatchewan River at a point approximately 60 Km east of Prince Albert, Saskatchewan and 494 Km downstream of the Alberta border (Figure 2.1).

With the exception of the scarp slopes between the major physiographic units, the North Saskatchewan basin consists mainly of a gently-rolling glacial plain with few major streams and large areas of internal drainage (PPWB 1982). The major tributary in Saskatchewan is the Battle River which originates in Alberta and joins the North Saskatchewan River in the area immediately downstream of the Battlefords. Other locally-significant tributaries include Monnery River, Big Gully Creek, Eagle Creek, Sturgeon River and Garden River.

The North Saskatchewan River valley is a glacial meltwater channel incised a few hundred metres into the surrounding plain. The valley is relatively constant in size and shape throughout the

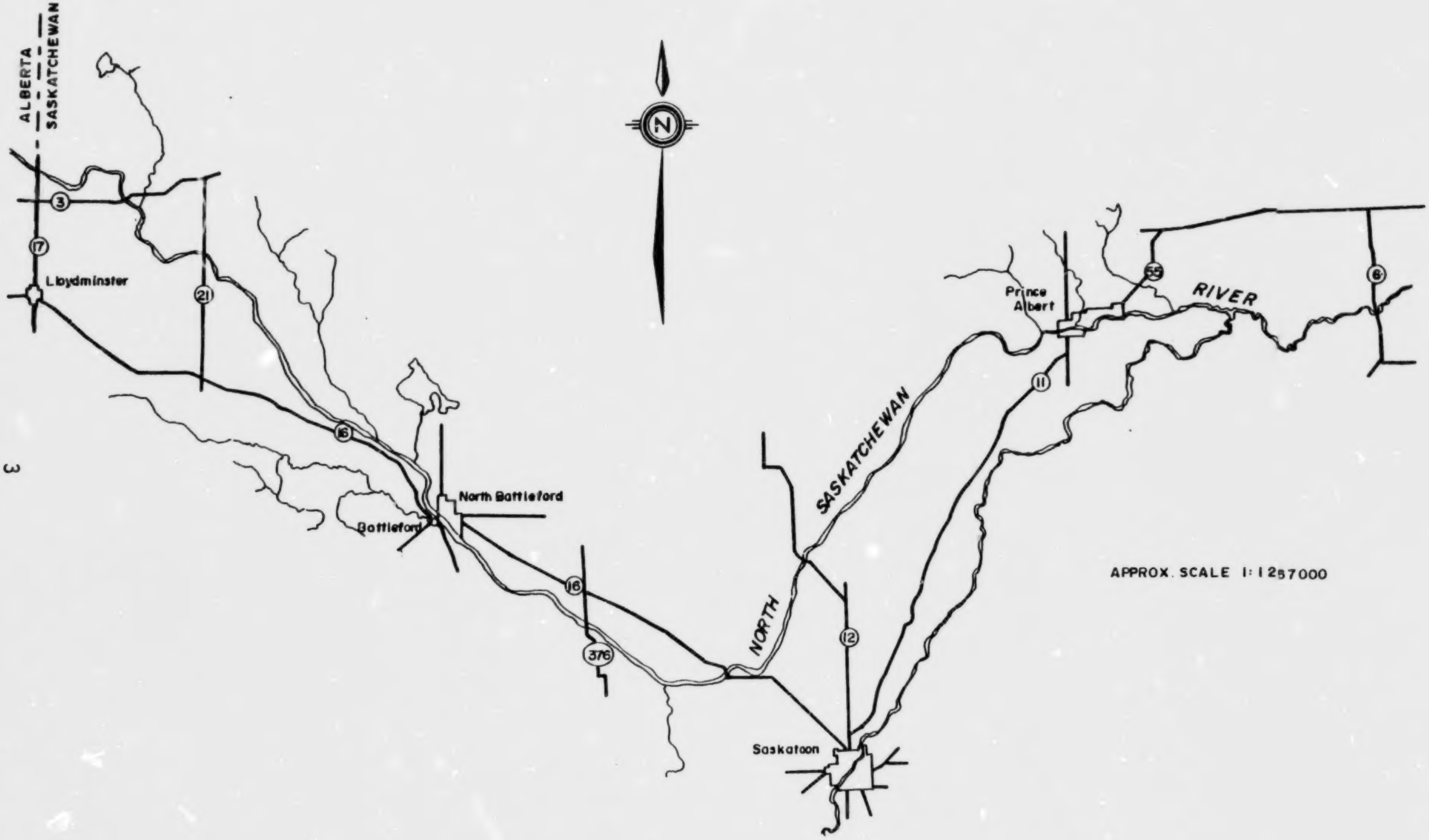

ALBERTA
SASKATCHEWAN
3
17
Lloydminster
21
16
North Battleford
Battleford
16
376
NORTH
SASKATCHEWAN
12
Saskatoon
11
Prince Albert
55
RIVER
6
N
APPROX. SCALE 1:1257000

Figure 1.1 , MAP OF THE NORTH SASKATCHEWAN RIVER

Saskatchewan reach and varies in width from two to four kilometres in most areas. The river in most reaches is generally broad and during high flow periods is considered a relatively swift-flowing river for the prairie environment. The river channel contains a large number of islands and sandbars.

In Saskatchewan, much of the area through which the river flows is broken agricultural land; aspen parkland occurs near the Alberta border and near Prince Albert portions of the boreal forest are encountered.

1.4 Hydrology

Historically, the natural flow regime of the North Saskatchewan River was characterized by very low winter flows, followed by two much higher flow periods: one in April and May associated with snowmelt from prairie tributaries, and one in June and July associated with mountain glacier meltwater and spring rainfall in headwater areas (Prairie Provinces Water Board 1982). This seasonal pattern has been altered in the recent past by the presence of the Brazeau (1965) and Bighorn (1972) hydroelectric dams in Alberta. Winter flows have increased and spring and summer flows decreased due to water storage practices in upstream areas related to this project. Total annual flow volumes have, however, not changed significantly (PPWB 1982).

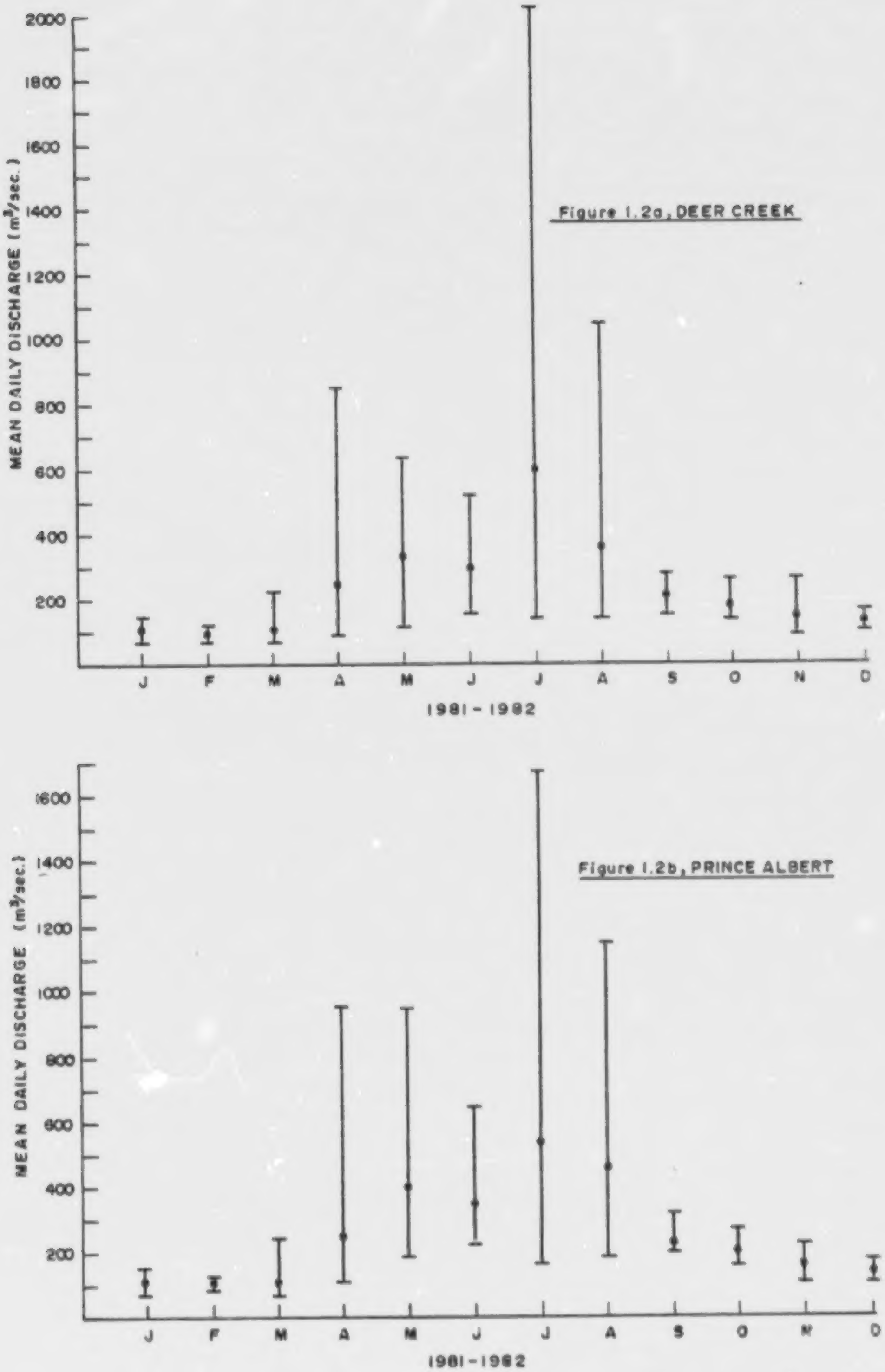


Figure 1.2, MONTHLY MEAN FLOWS (m^3/sec.) FOR THE NORTH SASKATCHEWAN RIVER AT DEER CREEK AND PRINCE ALBERT DURING THE PERIOD 1981 - 1982 (MEAN DAILY DISCHARGE AND RANGES).

Surface water flow data are available for two stations on the North Saskatchewan River - one near the Alberta border (Deer Creek) the other at Prince Albert. The mean daily discharges recorded at these stations during 1981 and 1982 are shown in Figure 1.2.

1.5 Water Users

The North Saskatchewan River, from its origin in the Rocky Mountains to its confluence with the South Saskatchewan River, is utilized by many different people, agencies and industries for a wide variety of purposes. In Saskatchewan approximately 150,000 people reside in the river basin. As of late 1984, 65 licences for use of the river water for domestic, municipal, industrial and irrigational purposes were in effect or were pending within Saskatchewan. A detailed list of licensed water users is presented in Appendix 1. The major water use locations along the river are shown in Figure 2.1.

The North Saskatchewan River is utilized as a source of water to supply drinking water to the Cities of Lloydminster, North Battleford and Prince Albert. As well, these communities use the river for reception of storm waters, and municipal and industrial effluents. A detailed description of the municipal and industrial effluents discharged to the lower reach of the North Saskatchewan River is presented in another report (Saskatchewan Environment, 1984). The volumes of water permitted to be withdrawn by these

Table 1.1

Summary of Major Licensed Water Uses
of the North Saskatchewan River*

Type of Use	Licensed Users	Total Volume Licensed for Use (m^3)
Municipal Supply	Lloydminster North Battleford Prince Albert	4.5×10^6
Irrigation	41 individual users	6.6×10^6
Industrial Supply	Prince Albert Pulp Company	7.7×10^7

*Saskatchewan Water Corporation file data 1984. (Appendix 1).

and other licensed users from the river each year is shown in Table 1.1. The Prince Albert Pulp Company (PAPCO) was the largest single licensed water user identified in terms of volume of water withdrawn from the river.

Along the Saskatchewan portion of the river, water is also withdrawn at 41 sites for the purpose of forage, cereal, market garden, root crop and horticultural and turf irrigation. Approximately 1,500 hectares of land are irrigated at these sites during the growing season. Demand for use of the river water for irrigational purposes is expected to increase in the future.

The major licensed industrial user of the river is the Prince Albert Pulp Company. River water is withdrawn from the north shore at a site located about 48 Km above the confluence. The water is used by the pulp mill for both industrial and domestic purposes. Treated effluent from the pulp mill is discharged to the North Saskatchewan River at a site about 3 Km downstream of the mill's water intake.

In addition to these licensed water uses, the river is also utilized by indigenous biota and wildlife and for the watering of livestock. It also serves as a source of domestic water supply and is a popular canoe route
during the summer. The magnitude of domestic and non-contact recreational use (e.g. canoeing, boating, camping, fishing) and of livestock watering use of the river, however, is unknown. Contact recreational use (e.g. swimming) of the river is not thought to be significant at present, but potentially may become an important water use if proposed reservoirs related to hydroelectric projects along the river are developed in the future. In the early 1900's steamboat navigation on the river also occurred.

Four ferries, located near Lloydminster, Paynton, Wingard and Cecil, operate during the open water season and represent an instream use of the river not directly influenced by water quality.

These locations are also used in winter as vehicle crossing points when thick ice cover permits safe movement across the river. However, warm water effluent discharges upstream of the Cecil Ferry crossing often reduce the thickness of ice on the north side and prevents ice crossing by vehicles for most of the winter season.

2. MONITORING PROGRAMS

2.1 Sampling Locations

Since 1970 Saskatchewan Environment has sampled monitoring stations on the North Saskatchewan River as part of the provincial surface water quality monitoring network. Historical water quality data from ten of these stations were considered for discussion in the present report. In order to supplement the water quality information concerning these ten stations an additional five stations were selected for examination during 1981-1982. A list of these 15 major water quality monitoring stations is presented in Table 2.1. The location of each station on the river is shown in Figure 2.1. Figure 2.1 is enclosed in the envelope attached to the rear cover of the report.

As indicated in Table 2.1 most monitoring of the provincial network stations involved the collection of samples from the midstream transect location. At several stations, however, samples were routinely collected from transect sites located either one-third of the river width from the left or right bank of the river. The left and right bank designations correspond to the northern and southern shores of the river when viewed in a downstream direction. In 1982, the monitoring activities at each station were expanded to include sampling of transect points not usually sampled routinely. This was done to provide data needed to assess the homogeneity of different variables across each river transect, and to provide an indication of the mixing and

Table 2.1

List of Major Water Quality Sampling Stations on the North Saskatchewan River Monitored Between 1970 and 1982

Location	Station Number	Transect Station (1) Locations	Distance (km) Above Confluence
Alberta-Saskatchewan Border	--	--	494.1
Lloydminster Ferry	1	L$\underline{M}$R	493.2
Highway 3 Crossing	5	L$\underline{M}$R	456.9
Highway 21 Crossing	8	L$\underline{M}$R	421.8
Paynton Ferry*	11	LMR	377.9
Highway 16 Crossing (N. Battleford)	15	L$\underline{M}$R	317.0
Highway 4 Crossing* (2)	19	NL NM NR SL SM SR	314.0
Highway 376 Crossing	25	L$\underline{M}$R	262.7
Highway 16 Crossing (Borden Bridge)	27	L $\underline{R}$	218.5
Highway 12 Crossing*	29	L$\underline{M}$R	174.7
Wingard Ferry*	32	L$\underline{M}$R	129.6
Crutwell Ferry*	33	LMR	92.2
Prince Albert Water Treatment Plant Intake	36	LM$\underline{R}$	62.3
Prince Albert Pulp Company Intake	42	$\underline{L}$MR	48.4
Cecil Ferry	44	$\underline{L}$M$\underline{R}$	36.2
Cole Rapids	46	LM$\underline{R}$	26.3

(1) L = 1/3 from left bank facing downstream N = North, S = South
M = mid-river
R = 1/3 from right bank facing downstream
$\underline{X}$ = underlining designates provincial monitoring network station

(2) sampling conducted on both sides of an island.

* = stations monitored only in 1981-82 study.

dispersion characteristics of major effluents discharged to the river. Information obtained from these sites was needed to determine the areas of the river to which priority should be given for further intensive water quality investigations.

2.2 Sampling Intervals

Over the 1970-1980 period historical water quality data was acquired by sampling the following five provincial network stations on a monthly basis:

- Highway 16 (Borden Bridge)
- Prince Albert water treatment plant intake
- PAPCO intake
- Cecil Ferry
- Cole Rapids

Owing to dangerous ice conditions, which occur on the river in early winter and in spring, sampling of the river at these times of year generally was not conducted.

The other five network stations (Table 2.1) were sampled on a quarterly basis. During 1981 and 1982 this routine monitoring was supplemented by the sampling of five additional river stations and, in 1982, by the sampling of several transect sites at each of these 15 stations on a monthly to bimonthly basis. A detailed summary of the sampling frequency at these stations in 1981-82 is presented in Appendix 2.

In addition to the water quality monitoring conducted by Saskatchewan Environment sampling of the North Saskatchewan River by Environment Canada at the Highway 3 bridge (Figure 2.1) had been conducted on a monthly basis since 1974 (Prairie Provinces Water Board 1983).

2.3 Variables

The water quality variables examined as part of the historical data collection at network monitoring stations (Table 2.1) from 1970 to 1980, as well as during the more intensive monitoring carried out at the fifteen study stations during 1981-1982, included field tests for pH, temperature, conductance (specific conductance), dissolved oxygen and physical characteristics of each sampling site. These stations were also examined for various chemical and bacteriological variables including nutrients, heavy metal and trace substances, colour, resin acids, sulphides, mercury, biocides, and indicator bacteria.

A list of the variables selected for discussion in the present report is presented in Table 2.2. A summary of the frequency at which these variables were determined in samples from individual transect stations in 1981 and 1982 is provided in Appendix 2.

Similar variables were also determined in samples routinely collected by Environment Canada at the Highway 3 monitoring site.

Table 2.2
List of Water Quality Variables Examined on the
North Saskatchewan River

Variable	Units of Measure
Nitrogen - Total Kjeldahl	mg/L
Nitrogen - Dissolved NO_2 and NO_3	mg/L
Nitrogen - Total Ammonia	mg/L
pH	pH units
Phosphorus - Total	mg/L
Phosphorus - Soluble Ortho	mg/L
Carbon - Total Organic	mg/L
Oxygen - Dissolved	mg/L
Temperature	^{o}C
Oxygen - Per Cent Saturation	per cent
Oxygen - Biochemical Demand, 5 day	mg/L
Turbidity	NTU
Residue - Nonfiltrable (TSS)	mg/L
Specific Conductance	usie/cm
Total dissolved solids	mg/L
Potassium	mg/L
Calcium	mg/L
Magnesium	mg/L
Sodium	mg/L
Sulphate	mg/L
Chloride	mg/L
Hardness-Total	mg/L
Alkalinity-Total	mg/L
Phenolic Material	ug/L
Resin Acids	mg/L
Sulphide	mg/L
Colour (apparent colour)	colour units
2,4-D	ug/L
Alpha-BHC	ug/L
Gamma - BHC (Lindane)	ug/L
Aluminum-Total	mg/L
Arsenic-Total	ug/L
Barium-Total	mg/L
Boron-Total	mg/L
Cadmium-Total	mg/L
Chromium-Total	mg/L
Cobalt-Total	mg/L
Copper-Total	mg/L
Cyanide-Total	ug/L
Lead-Total	mg/L
Mercury-Total	ug/L
Molybdenum-Total	mg/L
Nickel-Total	mg/L
Selenium-Total	mg/L
Silver-Total	mg/L
Uranium-Total	ug/L
Vanadium-Total	mg/L
Zinc-Total	mg/L
Coliforms-Total	no./100 mL
Coliforms-Fecal	no./100 mL
Streptococci-Fecal	no./100 mL

2.4 Data Acquisition/Analysis

Field measurements and the collection of water quality samples were carried out following techniques described in the Water Pollution Control Branch procedures manual (Saskatchewan Environment 1984).

Dissolved oxygen concentrations were generally determined by the Winkler procedure on samples collected and preserved in the field. Water temperatures were generally determined using an alcohol or mercury filled field thermometer applied to the 4L grab samples used for general chemical analyses at the time of their collection. Specific conductance and pH were also measured in the field on the samples used for temperature determinations.

In order to obtain baseline information about the heavy and trace metal content of suspended solids in the river a consultant was hired to obtain suspended solids samples from various locations along the river in summer of 1981. These samples were collected using a continuous centrifuge sampling device (Envirodata Sedisamp System - I) in July of 1981 under high flow condition. The samples were frozen after collection with portions later being analyzed by the consultant for inorganic content and particle size and by the Saskatchewan Research Council Laboratory for heavy and trace metal content of the oven-dried samples.

Preservation, where required (e.g. heavy metal, biocide samples), of river water samples was generally carried out in the field within 15 minutes of the time of sample collection.

Laboratory determinations of conductivity and pH, as well as analyses of samples for general chemicals, phenolics (prior to 1981) and indicator bacteria were carried out at the Provincial Laboratories in Regina. Heavy metals and trace substances, as well as phenolic material, resin acids and sulphides were generally determined on samples submitted to the Saskatchewan Research Laboratory in Saskatoon. Biocide analyses were generally conducted at the Environment Canada laboratory in Calgary.

Data concerning all samples collected since 1970 on the North Saskatchewan River by Saskatchewan Environment and Environment Canada are stored on the ESQUADAT and NAQUADAT computer systems and are available upon request.

For the purposes of this report the available water quality data for the period 1970-1982 were examined for indications of long-term trends towards significant temporal and spatial increases or decreases in the concentrations or levels of different variables at various sampling stations from the Alberta-Saskatchewan border to the confluence. Although samples were obtained from up to three transect sites at the 15 monitoring stations during the 1981-1982 period the transect sample data for all sites, except

Cecil Ferry were combined for purposes of discussion in this report. Only at Cecil Ferry were there sufficient transect data and sufficient differences apparent in the levels of many variables between transect sites to warrant separate comparison of transect sampling site results at this station.

Also, data for the 1981-1982 period were examined separately from the historical data because of the greater intensity of monitoring of selected variables during this latter period.

For the 1970-1982 and 1981-1982 periods the data concerning the selected variables (Table 2.2) are presented as long-term mean (average) values with the minimum and maximum values also presented to show the range of concentrations at which each variable was observed at the different sampling sites. These data for the 1970-1982 period have also been plotted for each water quality variable examined and the plots presented in the report in Appendix 7.

Also mean and range data for these variables are presented for spring and summer, fall, and winter seasons to show seasonal trends for selected variables in the river. Because of unsafe ice conditions on the river in spring relatively little water quality data is available for this season. For this reason and because similarly high flows occur in spring and summer, the available data for these seasons were combined for consideration in this report. For purposes of this report the seasonal data relate to the following months of each year in which monitoring was conducted:

Spring/Summer - April through August
Fall - September through November
Winter - December through March

Annual mean data for each sampling site are also presented to show long-term trends for selected variables throughout the river reach in Saskatchewan.

3. RESULTS AND DISCUSSION

Detailed data concerning all water samples collected since 1970 on the North Saskatchewan River by Saskatchewan Environment and by Environment Canada are stored on the ESQUADAT and NAQUADAT computer systems and are available upon request. A summary of Saskatchewan Environment data concerning mean, minimum, and maximum values for the variables listed in Table 2.2 for each sampling site examined during the period 1970 to 1982 is attached as Appendix 3. A summary of seasonal mean, minimum, and maximum values for each variable for the 1970 to 1982 monitoring period is attached as Appendix 4. Annual mean data for each variable at the monitoring stations for the same period is attached as Appendix 5. In Appendix 3 and 4 the data for each variable are presented in tables arranged in the same order in which the variables are discussed in this chapter of the report (see Table of Contents). In Appendix 5 the data concerning all variables, except indicator bacteria, are presented in tables arranged in order of the sampling stations examined in a downstream direction (e.g. Table 2.1). The results of heavy and trace metal analyses of suspended solids samples obtained from the river in July, 1981 are presented in Appendix 6.

Detailed information concerning the chemical and bacteriological characteristics of the major effluents discharged to the lower reach of the North Saskatchewan river has been compiled and discussed as part of another report on the water quality characteristics of the river in the Prince Albert area (Saskatchewan Environment 1984).

3.1 Dissolved Oxygen, Organics, Nutrients

3.1.1 Dissolved Oxygen

Dissolved oxygen concentrations in a river are influenced to a great degree by contact of the water with the atmosphere, by altitude, by water temperature which directly influences the solubility of oxygen in water, by water velocity, by aquatic plant growth, and by the loadings of organic materials whose decomposition utilizes oxygen.

Individual dissolved oxygen values provide information about the absolute quantity of this gas dissolved in water but do not give information about the degree of saturation of the water at the temperature occurring when the sample is obtained. For instance, an open water may contain an adequate quantity of dissolved oxygen for fish survival (e.g. 5 mg/L) but if this quantity present is less then accounted for by the solubility of oxygen at the recorded water temperature, there is an indication that some substance or process is utilizing oxygen at a rate exceeding its diffusion from the atmosphere or from photosynthesizing aquatic plants and algae. Such substances may be introduced to a river through effluent discharges or may occur due to naturally occurring high levels of labile organic matter or respiring plants and microorganisms.

In all rivers diurnal fluctuations of oxygen content are commonly observed. During periods of darkness, when photosynthetic contributions of oxygen to the water ends, plant respiration and microbial activity may utilize dissolved oxygen at a rate faster than diffusion from the atmosphere can replace it. Under such conditions oxygen concentrations below expected saturation levels are encountered in rivers. Reductions in dissolved oxygen content to levels below saturation are also frequently observed in rivers during daylight hours in areas directly influenced by high loads of organic material and nutrients associated with wastewater effluent discharges. If excessive quantities of oxygen consuming materials are present the level of dissolved oxygen in a river may fall below that required for the survival of fish or other aquatic animals. In Saskatchewan the surface water quality objective for dissolved oxygen has been established at 5 mg/L (Saskatchewan Environment 1975) to protect this most sensitive use of surface waters.

Data summaries concerning the long-term mean values, and annual mean values, for dissolved oxygen concentrations in the North Saskatchewan River from 1970 to 1982 are presented in Tables 3.1.1 and 3.1.2, respectively. The values for long-term mean dissolved oxygen concentrations at the 16 sampling sites ranged from 7.6 to 10.3 mg/L

(Table 3.4). The mean value for dissolved oxygen concentrations at the Alberta/Saskatchewan border between 1974 and 1982 reported by Environment Canada was 10.3 mg/L (PPWB 1983).

While the long-term mean values suggest that dissolved oxygen concentrations generally were above the surface water quality objective level of 5 mg/L minimum levels below this objective value were observed at 12 of the 15 monitoring sites during the 1970 - 1982 period. The observed minimum values (Table 3.1.1) in the upper reach of the river during the 1981-1982 period were less similar to those observed for the 1970-1982 period as a whole, with those in the lower river reach from Crutwell Ferry to Cole Rapids all being above the 5 mg/L objective level. This suggests that improvements in wastewater treatment in Prince Albert, and at the pulp mill made during the mid-1970's may have had a beneficial effect on the dissolved oxygen regime in the river. Increased winter flows stemming from reservoir operation in Alberta also likely contribute to the improved dissolved oxygen conditions in recent years.

Among the annual mean data (Table 3.1.2) there appears to have been generally a slight increase in mean levels of dissolved oxygen since 1971, and this again might relate to improvements in wastewater treatment upstream of the Saskatchewan/Alberta Border and at sites within Saskatchewan.

Water temperature has a major and direct influence on the solubility of oxygen in water and therefore it is expected that levels of dissolved oxygen in a river will vary with seasonal changes in water temperature. In the North Saskatchewan River the mean levels of dissolved oxygen between 1970 and 1982 were generally greatest during the fall season when water temperatures were relatively low and reaeration of the water was not inhibited by ice cover. Summaries of data concerning seasonal levels of dissolved oxygen and water temperatures during the 1970-1982 period presented in Tables A4.1 and to A4.3 of Appendix 4, respectively.

As indicated above with regard to the solubility of oxygen in water water temperature is of great importance in influencing the physical chemical and biological processes occurring in a river. Water temperature data concerning the North Saskatchewan River have been summarized for each monitoring site as long term means in Appendix 3. Seasonal means for each site have been presented in Table A4.3 (Appendix 4).

The range of mean water temperatures for the winter season was from 0.3-0.8°C and this is typical for rivers in northern temperate climates. Ice cover is present on the river for most of the winter. In fall mean water temperatures at the various monitoring sites ranged from 5.1°C to 11.0°C. During the spring/summer season generally higher mean water temperatures were recorded as expected with mean temperatures ranging from 13.3 to 20.7°C.

The mean values for oxygen saturation during the period 1971 to 1982 ranged from 65 to 96 per cent (Table A4.2). Like the long-term mean values for dissolved oxygen concentrations those for oxygen saturation tended to be highest during the fall seasons, and lowest during the winter, when ice cover and snow cover reduce reaeration and sunlight penetration into the water column, and low temperatures reduce the rate of oxygen production during daylight hours by algae. It is interesting to note with regard to the minima for oxygen saturation (Table 3.1.1) that data recorded for the period 1981-1982 generally involved greater values (range 47-65%) for stations in the lower reach (from Prince Albert to Cole Rapids) than were recorded for the 1970-1982 period as a whole (e.g. 7-25%). Again, this is believed to be related to increased winter flows and to improvements in wastewater treatment

TABLE 3.1.1
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Dissolved oxygen (mg/L)

Period:	1970 - 1982				1981-1982			
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	44	9.9	5.3	15.4	19	10.0	5.3	15.4
Highway 3	44	10.0	3.1	15.6	17	9.9	3.1	15.6
Highway 21	35	10.1	4.6	16.3	18	10.0	4.6	16.3
Paynton Ferry	16	10.3	5.5	16.0	16	10.3	5.5	16.0
Highway 16	51	9.1	4.4	15.7	24	8.5	4.5	13.1
Highway 4	24	9.3	5.3	13.0	24	9.3	5.3	13.0
Highway 376	39	8.9	3.7	14.1	23	8.4	5.1	13.5
Borden Bridge	84	9.6	3.6	16.1	38	9.6	5.6	13.4
Highway 12	23	9.5	3.8	15.2	8	8.3	5.0	13.5
Wingard Ferry	10	7.6	2.4	13.6	4	8.6	2.4	13.2
Crutwell Ferry	4	9.8	9.3	10.4	4	9.8	9.3	10.4
P.A. WTP	137	9.4	3.5	16.4	14	10.3	6.6	14.7
PAPCO	149	9.1	2.4	18.0	14	10.7	7.0	14.9
Cecil Ferry N	170	8.8	3.4	16.3	16	9.1	5.7	13.6
Cecil Ferry S	162	9.2	1.6	16.1	15	9.5	5.8	14.9
Cole Rapids	99	9.3	1.0	16.9	18	10.4	5.6	14.5

SSWQ Obj: 5 mg/L

Variable: Saturation of Dissolved Oxygen (Percent)

Period:	1970 - 1982				1981-1982			
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	41	87	7.3	144	18	93	7.3	144
Highway 3	41	86	23	120	17	93	23	119
Highway 21	30	88	35	120	18	93	35	120
Paynton Ferry	16	96	64	158	16	96	64	158
Highway 16	48	84	32	122	24	82	33	114
Highway 4	24	91	61	148	24	91	61	148
Highway 376	36	81	27	124	23	82	38	124
Borden Bridge	86	87	26	148	39	90	53	132
Highway 12	22	81	28	140	8	85	56	140
Wingard Ferry	9	65	26	112	4	85	27	112
Crutwell Ferry	4	95	80	108	4	95	80	108
P.A. WTP	134	85	25	137	14	85	47	128
PAPCO	147	82	17	156	14	88	50	118
Cecil Ferry N	169	79	25	147	16	76	41	99
Cecil Ferry S	159	81	8	153	15	79	45	113
Cole Rapids	98	86	7	136	18	90	64	113

SSWQ Obj: Not established.

n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective

Table 3.1.2

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Dissolved oxygen (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster		6.2	8.8	10.2	10.6	11.1	8.5	10.6	9.6		9.9	10.6	9.6
Highway 3		9.1		10.4	10.7	11.2	10.0	10.2	9.5		9.2	10.3	9.3
Highway 21		9.3		10.6	11.0	14.1	8.3	11.3	8.5		9.2	10.0	10.1
Paynton Ferry												10.8	10.0
Highway 16		8.7	7.4	10.5	11.9	9.9	9.8	11.8	8.5		7.8	7.5	9.9
Highway 4												7.8	10.3
Highway 376		8.9		10.7	11.6	9.3	8.2	11.1	8.7		9.1	7.6	9.5
Borden Bridge	8.9	7.0	7.1	9.4	11.5	9.1	9.4	11.6	9.8	10.3	10.3	9.2	10.0
Highway 12		8.7	9.1	12.8	12.6	10.4	7.6	12.8	7.9			10.1	7.1
Wingard Ferry		8.6	4.8				6.8		8.1				8.6
Crutwell Ferry													9.8
P.A. WTP		10.4	8.3	9.4	9.1	9.6	10.6	9.6	9.4	9.0	8.1	10.8	9.6
PAPCO	13.7	7.8	8.2	9.2	9.0	9.3	10.1	10.1	9.9	9.6	9.8	12.2	9.9
Cecil Ferry N	7.7	7.5	8.1	8.7	8.8	9.2	9.6	9.1	10.0	10.2	9.2	9.4	8.9
Cecil Ferry S	9.9	7.8	8.4	9.4	9.3	9.6	10.3	9.7	9.8	9.2	8.7	9.9	8.9
Cole Rapids		7.1	8.5	8.5	9.4	8.8	9.9	10.4	10.2	9.6	10.3	10.7	10.1

SSWQ Obj: 5 mg/L

Table 3.1.3

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Saturation of Dissolved Oxygen (%)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster		46	64	102	84	99	63	82	73	100	91	95	92
Highway 3		67		102	80	69	81	87	72	100	74	95	89
Highway 21		67		111	107		62	87	64		75	92	94
Paynton Ferry												96	97
Highway 16		74	68	95	114	90	79	113	83		60	73	93
Highway 4												77	101
Highway 376		65			116	83	60	87	67		69	74	92
Borden Bridge	88	51	66	71	96	82	76	107	93	81	98	86	93
Highway 12		64	67	99	113	92	56	104	58			101	80
Wingard Ferry		62	35				52						85
Crutwell Ferry													95
P.A. WTP		92	73	86	82	85	100	85	89	82	79	92	75
PAPCO	101	69	71	84	78	81	115	97	96	99	96	96	83
Cecil Ferry N	72	68	71	80	76	82	90	83	96	87	86	78	74
Cecil Ferry S	92	70	75	86	81	87	96	90	94	70	76	83	75
Cole Rapids		72	87	77	85	79	92	94	100	94	100	88	92

SSWQ Obj: Not established.

implemented at Prince Albert and at the pulp mill. A similar trend is apparent for the lower reach of the river among the annual mean data presented in Table 3.1.3.

In addition to the routine monitoring of dissolved oxygen and temperature levels of the river intensive monitoring of these variables was carried out in July of 1981 to determine the diurnal dissolved oxygen/temperature characteristics of the river at selected sites in the river reach from Highway 3 to Borden Bridge. Diurnal monitoring was conducted at four stations using a continuous dissolved oxygen/temperature recording device or by obtaining samples for determination of these variables at intervals of 14 minutes to 4 hours between measurements. The results of this monitoring have been summarized in Table 3.1.4.

The minimum and maximum values for dissolved oxygen at these four sites ranged from 4.7 to 8.8 mg/L and 8.2 to 13.5 mg/L, respectively. The minimum values in each case were recorded for the early morning darkness periods on each sampling date. This is typical of the diurnal fluctuation of dissolved oxygen in most rivers. These minimum values fall within the range of dissolved oxygen minima recorded for these four sites throughout spring/summer seasons of the 1970-1982 period (Table A4.1).

The results of dissolved oxygen monitoring of the North Saskatchewan River from 1970 to 1982 indicate that the mean levels of dissolved oxygen exceeded the minimum of 5 mg/L specified in the provincial surface water quality objectives (Tables 3.1.1, 3.1.2). Annual mean values for dissolved oxygen and oxygen saturation indicate a slight increase in dissolved oxygen levels at most monitoring sites since the early 1970's (Tables 3.1.2, 3.1.3). A similar increase in dissolved oxygen mimima at stations in the lower reach, below Prince Albert, since the early 1970's (Table 3.1.1, A4.1) may be at least partly the result of improved tretment of municipal and industrial wastewaters discharged to this reach of the river.

Therefore, while the dissolved oxygen concentrations of the North Saskatchewan River appear to have been adequate for all human usage of the river and generally adequate for the survival of fish and other aquatic life, periodically levels of dissolved oxygen less than 5 mg/L have been observed at most sites on the river since 1970.

It should be noted that most dissolved oxygen determinations on the river were made during the 1970-1982 period were made during daylight hours when dissolved oxygen minima are least likely to be observed. The lower dissolved oxygen minima recorded for the lower reach of the

Table 3.1.4

DIURNAL DISSOLVED OXYGEN AND OXYGEN SATURATION VALUES AT SELECTED STATIONS ON THE NORTH SASKATCHEWAN RIVER DURING JULY 1981

Monitoring Station	Station Number	Sampling Period	Dissolved Oxygen Concentration (mg/L)		Saturation (%)	
			Minimum	Maximum	Minimum	Maximum
Highway 3	5	July 13:1708 - July 15:1052*	8.8	13.5	98	154
Highway 16	15	July 20:1305 - July 21:1725	4.7	8.2	55	96
Highway 376	25	July 20:1623 - July 21:1037*	5.3	8.3	60	98
		July 20:1115 - July 21:1620	5.1	8.2	60	98
Borden Bridge	27	July 20:1015 - July 21:1540	5.6	8.4	67	101

* recorded at 14 minute intervals by continuous monitor; all other data obtained at 4-hour intervals by manual sampling.

river may therefore indicate that water quality problems related to more severe oxygen depletion in this reach of the river may occur during darkness hours at least periodically. Subsequent diurnal monitoring of dissolved oxygen levels in the river at Cecil Ferry were conducted in autumn of 1983 under ice-free conditions to address this concern. Dissolved oxygen minima recorded for darkness hours during that investigation were all above 11 mg/L (Saskatchewan Environment 1984).

3.1.2 Organics

Of the variables which generally relate most closely to oxygen consumption in rivers total organic carbon (TOC) and biochemical oxygen demand (BOD) were monitored routinely at most sampling stations between 1970 and 1982.

TOC is composed of both dissolved and particulate organic carbon with the dissolved forms generally being predominant in most surface waters. The majority of organic carbon in water is composed of humic substances and partly degraded plant and animal materials. Photosynthetic activities of algae and aquatic plants also contribute organic carbon to water. The amounts of various forms of organic carbon in water vary greatly with river flow and especially with the growth cycle of vegetation.

The levels of TOC in surface waters generally range from 1 to 30 mg/L with waters containing less than 3 mg/L TOC considered to be relatively clean. High levels of TOC in surface waters are undesirable because they contribute to oxygen consumption through their decomposition.

BOD of a water is the amount of oxygen required to oxidize organic matter by aerobic microbial decomposition to a stable inorganic form. BOD is usually determined using specific quantities of water incubated at 20°C for a period of five days.

Like TOC, organic matter that contributes to BOD in water may be derived from natural sources such as the breakdown of aquatic plants, algae and animal debris as well as organic materials derived from the watershed (e.g. leaf litter). Pulp mills, municipal and agricultural wastes can also add significant quantities of oxygen-demanding substance to water. High BOD loads can pose a threat to aquatic life by depressing oxygen concentration to unsuitable levels. Water with high BOD may also be unsuitable for irrigation since they may restrict plant growth.

Waters with BOD levels less than 4 mg/L are considered relatively clean while those with BOD levels above 10 mg/L deemed polluted (Environment Canada 1979).

A summary of long-term mean, minimum and maximum values for TOC and BOD are presented in Tables 3.1.5 for the 1970-1982 and 1981-1982 periods. Seasonal mean data concerning these variables are presented in Tables A4.4 and A4.5 of Appendix 4.

The long-term mean values for TOC and BOD during the 1970 - 1982 period ranged from 5.9-15 mg/L and 2.0-6.1 mg/L, respectively (Table 3.1.5). Mean values for both variables were relatively uniform from the Alberta border to the Prince Albert area indicating that little net change in the concentration of oxygen consuming materials occurred in this upper reach of the river. River water entering Saskatchewan from Alberta at the Lloydminster ferry crossing was characterized by annual mean TOC and BOD values ranging from 1.0 to 12 mg/L TOC and 0.2 to 4.8 mg/L BOD (Tables 3.1.6, 3.1.7) for the period 1970-1982. Water quality data reported by Alberta Environment (1983) for the provincial border monitoring site near Lea Park, Alberta, included mean values of TOC (7.4 mg/L) and BOD (1.1 mg/L) for the period 1970-1977, and a mean TOC value of 3.1 mg/L for the period 1977-1981. These values are within the range of values observed among data obtained by Saskatchewan Environment (Tables 3.1.6, 3.1.7). Significantly higher levels of mean values for both variables, however, were observed at stations between

Prince Albert and Cole Rapids for the 1970-1982 period (Table 3.1.5). The highest long-term mean values for TOC and BOD were recorded for the northern station at Cecil Ferry. This was presumably due to the influence of the pulp mill effluent plume. These trends are shown pictorially in Figure 3.1.

The long-term mean values for TOC and BOD at each station below the Prince Albert water treatment plant, however, were consistently lower for the 1981-1982 period than for the 1970-1982 period as a whole. This apparent reduction in mean TOC and BOD at these downstream sites may relate mostly to improvements in wastewater treatment at Prince Albert, and at the pulp mill, that were implemented in the mid-1970's. Summaries of the annual mean values of TOC and BOD at each sampling site are presented in Tables 3.1.6 and 3.1.7, respectively. Relatively little data was available concerning TOC during the period 1970-1973.

Considerable variation in annual mean values for TOC at each station was observed with levels of TOC showing a general decrease at most sites between 1974 and 1982 (Table 3.1.6). Data for 1982 involved generally lower mean TOC values than were observed in any other year. The reasons for the relatively low values for 1982 are not readily apparent. As was noted for the long-term mean values for

TOC and BOD (Table 3.1.5) the highest annual mean values for these variables were generally observed in relation to the northern monitoring site a Cecil Ferry. Significant decline in annual BOD levels with time was not apparent for most stations although a slight decline in BOD annual mean values can be seen to have occurred at the Cecil Ferry northern station (Table 3.1.7).

The seasonal TOC and BOD long-term mean data for each sampling station are recorded in Tables A4.4 and A4.5 of Appendix 4, respectively. These data show generally lower values for both TOC and BOD occurring at all stations during the winter seasons than were recorded for the spring/summer and autumn periods from 1970 to 1982. The one exception concerns the Cecil Ferry north sampling site which is directly influenced by pulp mill effluent. The relatively lower winter levels of TOC and BOD were likely due to reduced levels of organic materials since plant and algae production and inputs of organic material from the watershed are largely curtailed in winter. Contributions of TOC and BOD from the pulp mill effluent discharged to the river probably accounts for the long-term incidence of generally minimum oxygen saturation levels being observed in the river reach from Cecil Ferry to Cole Rapids than were recorded for stations in the upper reaches of the river, above Cecil Ferry (Tables 3.1.1, A4.1). As noted

TABLE 3.1.5
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Organic Carbon (mg/L)

Period:		1970 - 1982				1981-1982		
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	59	7.3	0.0	15	37	6.8	0.0	15
Highway 3	53	8.1	0.0	23	25	7.5	0.0	16
Highway 21	40	6.2	0.0	14	22	5.4	0.0	14
Paynton Ferry	24	7.5	0.0	15	24	7.5	0.0	15
Highway 16	53	7.4	0.0	18	31	7.0	0.0	18
Highway 4	31	6.4	0.0	15	31	6.4	0.0	15
Highway 376	44	7.0	0.0	27	28	5.7	0.0	16
Borden Bridge	95	7.3	0.0	24	54	7.3	0.0	24
Highway 12	27	7.0	0.9	15	14	7.7	0.9	15
Wingard Ferry	12	5.9	0.9	10	10	6.8	2.0	10
Crutwell Ferry	15	7.1	0.9	15	15	7.1	0.9	15
P.A. WTP	101	9.2	0.9	48	12	10	2.0	25
PAPCO	85	10	0.0	45	15	9.0	2.0	18
Cecil Ferry N	109	15	0.5	45	17	12	0.9	40
Cecil Ferry S	106	9.1	0.0	50	17	8.2	1.0	22
Cole Rapids	82	9.7	0.9	23	23	7.1	0.9	19

SSWQ Obj: Not established.

Variable: Biochemical Oxygen Demand (mg/L)

Period:		1970 - 1982				1981-1982		
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	74	2.2	0.2	8.0	42	2.4	0.6	8.0
Highway 3	63	2.1	0.3	6.5	30	2.1	0.6	4.4
Highway 21	45	2.0	0.4	5.5	24	2.0	0.6	4.8
Paynton Ferry	30	2.0	0.6	4.6	30	2.0	0.6	4.6
Highway 16	68	2.7	0.2	40	35	2.1	0.6	4.4
Highway 4	35	2.6	0.6	5.0	35	2.6	0.6	5.0
Highway 376	49	2.1	0.4	4.8	29	2.3	0.6	4.0
Borden Bridge	111	2.4	0.4	12	59	2.6	0.6	12
Highway 12	33	3.0	0.3	13	13	3.5	2.2	4.6
Wingard Ferry	16	2.6	0.4	4.4	10	3.6	1.6	4.4
Crutwell Ferry	12	3.4	2.6	4.2	12	3.4	2.6	4.2
P.A. WTP	151	3.1	0.2	40	18	3.3	0.2	22
PAPCO	145	2.5	0.1	15	12	1.3	0.1	4.0
Cecil Ferry N	151	6.1	0.6	42	12	2.7	1.0	4.8
Cecil Ferry S	170	2.8	0.0	13.5	19	1.9	0.0	5.0
Cole Rapids	111	2.6	0.4	7.0	23	2.4	0.4	4.2

SSWQ Obj: Applies to effluents; should not create a dissolved oxygen content of less than 5 mg/L.

n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective

Figure 3.1, MEAN CONCENTRATION OF TOTAL ORGANIC CARBON (TOC) AND MEAN LEVELS OF BIOCHEMICAL OXYGEN DEMAND (BOD) AT SITES ALONG THE NORTH SASKATCHEWAN RIVER DURING THE PERIOD 1970 - 1982.

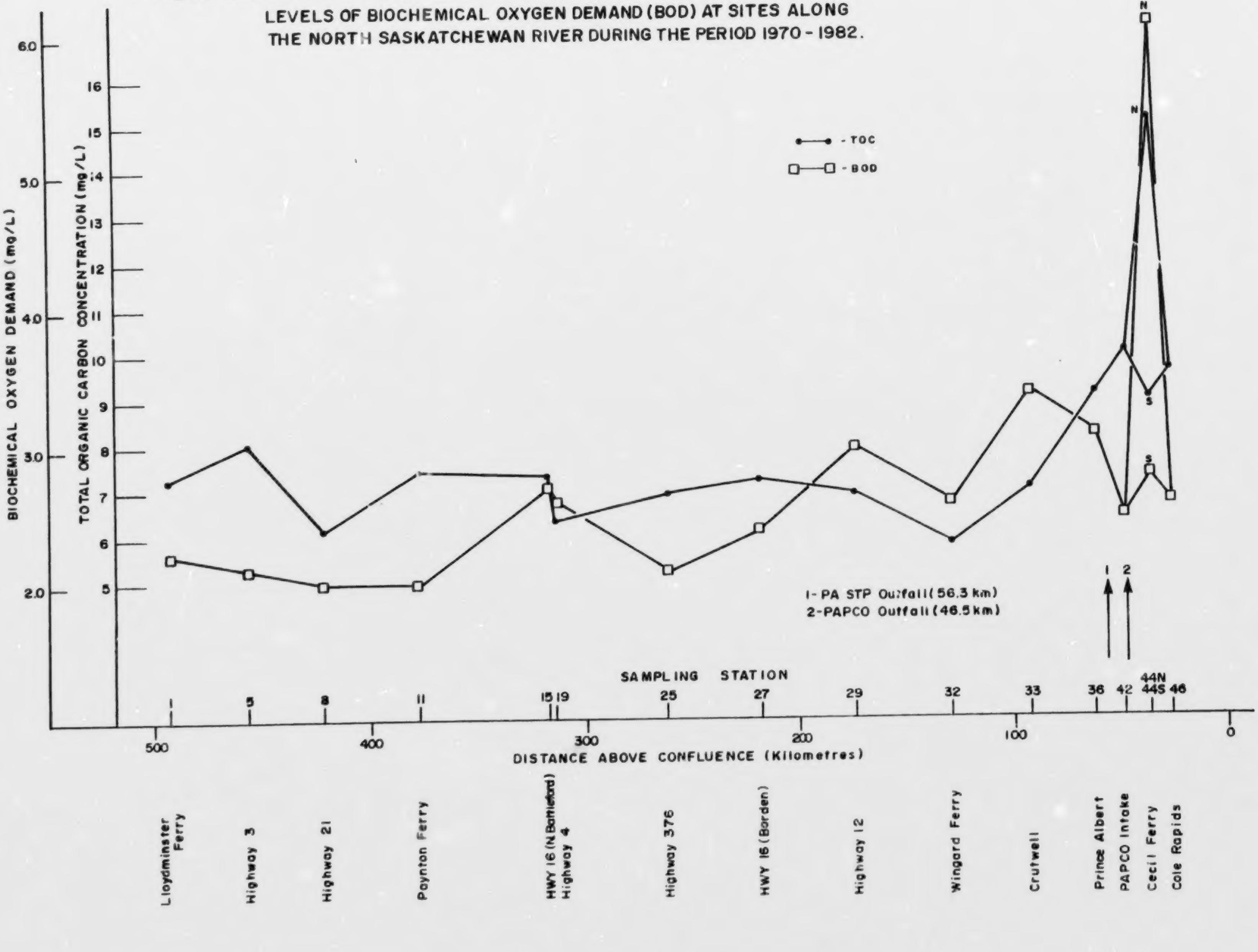


Table 3.1.6

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Total Organic Carbon (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster					11	7.5	3.0	6.5	1.0	0.9	12	2.3	2.5
Highway 3					12	5.0	5.7	9.6	4.0	2.0	8.8	10.8	2.6
Highway 21					11	6.0	4.0	5.5	2.0		7.3	9.7	2.4
Paynton Ferry												1.4	2.5
Highway 16					11	9.3	4.8	10	2.6		8.5	9.2	4.4
Highway 4												9.8	3.9
Highway 376					15	8.0	6.0	7.3	0.9		9.0	8.8	2.6
Borden Bridge					12	6.3	5.5	9.0	5.5	4.3	9.9	10.1	5.3
Highway 12					12	6.0	2.6	11	1.0		7.0	6.5	8.0
Wingard Ferry							2.0		0.9				6.8
Crutwell Ferry													7.1
P.A. WTP				15	15	6.6	8.3	8.1	7.7	5.6	12	11.5	3.0
PAPCO				15	16	7.1	11	9.1	8.8	7.0	9.3	9.4	8.8
Cecil Ferry N				24	22	12	15	14	12	12	17	15.8	8.4
Cecil Ferry S				14	17	7.1	7.9	7.6	8.5	4.3	11	8.8	7.5
Cole Rapids				15	14	10	8.0	11	11	4.9	14	8.2	6.4

SSWQ Obj:

Table 3.1.7

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Biochemical Oxygen Demand (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster		0.2	2.0	2.1	2.1	4.8	2.4	1.3	1.0	1.2	1.0	2.3	2.5
Highway 3		0.8		2.0	2.3	3.2	3.1	1.6	0.8	1.8	1.2	2.3	2.1
Highway 21		0.8		3.0	3.1	2.2	2.5	1.2	0.6		1.2	1.6	2.3
Paynton Ferry												1.4	2.5
Highway 16		1.0	14	2.4	2.4	3.8	2.1	2.8	0.9	4.4	1.2	2.0	2.3
Highway 4												2.2	2.8
Highway 376		1.4		1.1	2.8	3.2	1.7	1.1	0.6		1.6	2.3	2.3
Borden Bridge	2.6	1.2	1.1	1.3	2.2	4.9	2.3	2.5	2.0	2.4	2.2	1.9	3.0
Highway 12		0.9	4.6	1.7	2.9	4.1	1.5	1.0	0.6		3.8	2.6	3.6
Wingard Ferry		1.0	0.8				1.0		0.8				3.6
Crutwell Ferry													3.4
P.A. WTP		3.7	2.5	3.8	2.4	3.5	2.8	2.0	2.8	2.5	5.3	3.8	2.6
PAPCO	1.0	2.1	1.8	3.1	3.4	3.2	3.4	2.2	2.9	2.7	2.2	0.7	1.8
Cecil Ferry N	16	12	5.1	4.2	4.2	4.3	4.3	3.7	4.3	19	2.9	1.3	3.2
Cecil Ferry S	3.9	3.0	2.9	3.0	2.8	3.5	2.9	2.4	3.2	3.1	1.7	1.3	2.3
Cole Rapids		3.3	2.3	2.1	3.1	2.5	3.0	2.3	3.4	1.7	1.8	1.3	2.8

SSWQ Obj: Applies to effluents; should not create a dissolved oxygen content of less than 5 mg/L.

in Section 3.1.1 the dissolved oxygen data for the 1981-1982 period at stations in the lower river reach indicate a relative improvement in the dissolved oxygen regime in this reach, especially with regard to dissolved oxygen minima. Again, this may be related to improvements in wastewater treatment made at the pulp mill in the mid-1970's (Saskatchewan Environment 1984). Even though the pulp mill effluent discharge has an apparent impact on the river by increasing the TOC and BOD levels at Cecil Ferry north, the impacts of this effluent on the water quality of the river with respect to dissolved oxygen may have been limited mostly to the immediate vicinity of the outfall since mean dissolved oxygen and saturation-levels at the next downstream site (Cole Rapids) indicate a recovery to upstream levels for these variables (Table 3.1.1).

While higher values, relative to other monitoring sites, of mean levels of TOC (Table 3.1.6) and BOD (Table 3.1.7) at Cecil Ferry North were consistently observed since 1970 the levels of both variables have generally decreased at all sites since that time. Except perhaps within the immediate outfall areas the discharge of municipal and industrial (pulp mill) effluents to the river do not appear to have caused significant daytime oxygen depletions (Table 3.1.1). There remains concern, however, over the potential for oxygen depletion in the lower reach of the river during darkness hours when winter ice cover is present.

3.1.3 Nutrients

Nitrogen and phosphorus are important water quality variables since they serve as major nutrients influencing plant and algae growth in aquatic systems. When supplies of nitrogen and phosphorus are abundant, as is often the case with rivers in the prairie environment, high levels of plant and algae growth can result. Through decomposition of the resultant botanical material and through dark respiration by plants and algae during night periods, increased consumption of dissolved oxygen can result and deplete oxygen in the water column.

Increased plant and algal growth can also interfere with water uses related to fisheries, navigation, recreation, and water supply. High levels of algae or decaying plant litter may also create taste and odour problems in waters used for drinking water supplies. Municipal and industrial wastewaters, as well as drainage from agricultural watersheds, can contribute substantial quantities of these nutrients when discharged to a river.

Nutrient levels, particularly those for phosphorus, usually display marked seasonal variations in rivers owing to uptake of phosphorus by growing attached aquatic plants and algae, and to seasonal variations in river flow. For example, in summer low phosphorus levels would be expected because of uptake related to plant growth in this season. Water sampling and analyses for total phosphorus would not include that fraction of phosphorus taken up by plants and benthic algae, but would include phosphorus associated with planktonic and suspended algae and other phosphorus-containing materials in the water column.

In autumn, moderate levels of phosphorus would be expected in the water because of leaching of nutrients from dead and senescing plants and reduced uptake by attached plants and algae under the reduced light and temperature conditions of fall. High nutrient levels would be expected in winter because of markedly reduced uptake by plants and increased quantities of decaying plant debris in the water. Conversely, in spring low phosphorus levels would be expected during spring runoff events during which large quantities of ice and snowmelt water enter the river.

These expected trends in nutrient levels might not apply, however, to rivers in which relatively little aquatic plant growth occurs or where high nutrient levels are associated with increased suspended sediment loads accompanying high flow events.

3.1.3.1 Nitrogen

In surface waters nitrogen may be present in a variety of chemical forms. Organic nitrogen usually occurs as a relatively high proportion of the total nitrogen present and is usually in the form of living and dead plant and animal material or as nitrogenous substances (e.g. proteins, amino acids) derived from biological sources. Total Kjeldahl nitrogen (TKN) which includes total organic nitrogen plus ammonia (NH_3 plus NH_4^+ nitrogen) is frequently determined to measure the major quantity of nitrogen present in water. Nitrogen is also usually present in inorganic forms of which nitrite and nitrate ions and ammonia and/or ammonium ions are the chemical inorganic forms of most interest from the water quality standpoint. These important inorganic forms of nitrogen may be contributed to a river through runoff especially from agricultural lands in watersheds, from ground water infiltration, from storm sewer discharge, from wastewater (e.g. sewage) discharges, from rainfall, and as direct or indirect byproducts of decomposition of waterborne plant and animal debris. Nitrogen, in various forms may also be added to an aquatic system through the nitrogen fixing activities of aquatic microorganisms (e.g. bacteria, blue-green algae).

In Saskatchewan a surface water quality objective has been established for the variable, total nitrogen (total inorganic and organic), as 1.0 mg/L. It is recognized, however, that many surface waters in southern Saskatchewan have naturally high levels of nitrogen. The surface water quality objective for nitrogen is therefore not applicable to such waters although further increases through effluent disposal or other means is considered undesirable. Surface water quality objectives concerning the inorganic forms of nitrogen (e.g. nitrate, ammonia) have not been established.

Summaries of long-term mean, minimum and maximum values for total Kjeldahl nitrogen (TKN) and nitrate-nitrogen, and for ammonia nitrogen for stations on the North Saskatchewan River are presented in Tables 3.1.8 and 3.1.9, respectively. Separate summaries of annual mean data for these three variables are presented in Tables 3.1.10, 3.1.11 and 3.1.12, respectively.

Seasonal mean data concerning TKN, nitrate nitrogen and ammonia nitrogen for the periods 1970-1982, and 1981-1982 are recorded in Tables A4.6, A4.7, and A4.8 of Appendix 4.

Long-term mean values for TKN (Table 3.1.8) were relatively uniform from the Alberta border to the Wingard ferry station with slightly higher levels of TKN (1.0-1.3 mg/L) being observed in the river reach below Prince Albert. The exception to this is a high mean value (1.6 mg/L) at Highway 16. Data for the 1981-1982 period, however, showed generally lower mean TKN values in this lower river reach than were observed during the 1970-1982 period as a whole. Annual mean data (Table 3.1.10) indicate a general trend towards lower TKN values over time at all sampling sites since 1976. The reason for this general decline in mean TKN levels since 1976 most likely relates to changes made in the analytical procedures for TKN undertaken at the Provincial Laboratories in 1976. Annual mean values for TKN at most stations nevertheless were near to or slightly above the provincial surface water quality objective concerning total nitrogen, a variable usually comprised largely of TKN. However, such levels of TKN are commonly encountered in surface waters on the prairies.

The long-term mean values for nitrate nitrogen at sites along the North Saskatchewan River between 1970 and 1982 ranged from 0.15 to 0.40 mg/L. The nitrate-nitrogen levels varied considerably at individual sites but the long-term mean values were relatively uniform from the Lloydminster ferry crossing to the Prince Albert area (Table 3.1.8). For the 1970-1982 period and during the 1981-1982 period higher levels of nitrate-nitrogen characterized the station on the river reach below the Prince Albert area. Mean levels at Cole Rapids, however, indicate a decline in nitrate-nitrogen concentrations to levels observed at most sites upstream of Prince Albert. The increase in nitrate-nitrogen in the lower reach of the river below Prince Albert may at least be partly attributable to contributions of nitrate-nitrogen to the river from the discharge of municipal and industrial effluents to this reach of the river. However, such trends were not apparent among annual mean data concerning these stations (Table 3.1.11).

A surface water quality objective for nitrate-nitrogen has not been established for waters of Saskatchewan. However, generally all data for this variable was well below the current maximum acceptable concentration of 10 mg/L pertaining to drinking water (Saskatchewan Environment, 1980).

The long-term mean values for ammonia-nitrogen for the 1970-1982 period ranged from 0.06 to 0.67 mg/L generally higher mean values occurring at stations between Prince Albert and Cole Rapids (Table 3.1.9). A single relatively high mean value in the upper river reach (e.g. 0.67 mg/L) occurred at the Highway 16 station and is largely due to a very high individual sample result (e.g. 31 mg/L). Generally lower mean ammonia-nitrogen values, however, were observed for the entire reach of the river in Saskatchewan during the 1981-1982 period than were recorded for the 1970-1982 period as a whole. As was observed for annual mean TKN levels (Table 3.1.10) annual mean levels of ammonia-nitrogen showed a significant decline at all stations along the river in years since 1976. Again this reduction in mean levels of ammonia-nitrogen is believed to be related mostly to changes in analytical procedures introduced in 1976. In the lower reach of the river this trend may also be partly related to improvements in wastewater treatment.

Seasonal mean values for TKN, nitrate-nitrogen, and ammonia-nitrogen are recorded in Tables A4.6, A4.7, and A4.8, respectively. The seasonal mean values for each of these variables during the 1970-1982 tended to be higher at most stations

TABLE 3.1.8
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Kjeldahl Nitrogen (mg/L)

Period:	1970 - 1982				1981-1982			
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	69	.96	.20	7.8	38	.76	.40	1.9
Highway 3	61	.85	.10	2.4	28	.70	.20	1.6
Highway 21	43	.83	.20	2.4	22	.74	.20	2.0
Paynton Ferry	27	.71	.10	3.3	27	.71	.10	3.3
Highway 16	63	1.6	.10	39	32	.78	.10	1.6
Highway 4	33	.83	.10	1.4	33	.83	.10	1.4
Highway 376	47	.85	.20	2.4	29	.77	.20	1.6
Borden Bridge	109	.79	.10	3.7	58	.69	.10	2.3
Highway 12	34	1.1	.30	2.5	14	.99	.60	1.8
Wingard Ferry	15	.96	.40	1.8	10	.75	.60	1.1
Crutwell Ferry	15	1.0	.40	1.8	15	1.0	.40	1.8
P.A. WTP	147	1.2	.10	17	16	1.8	.20	17
PAPCO	130	1.2	.20	3.8	18	.98	.20	3.0
Cecil Ferry N	156	1.3	.16	5.7	21	.85	.30	2.1
Cecil Ferry S	156	1.1	.20	3.7	21	.88	.20	3.4
Cole Rapids	107	1.0	.20	11.4	27	.90	.20	2.2

SSWQ Obj: 1.0 mg/L as total nitrogen

Variable: Nitrate Nitrogen (mg/L)

Period:	1970 - 1982				1981-1982			
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	73	.26	.02	.66	42	.21	.03	.61
Highway 3	63	.29	.02	.64	30	.25	.03	.64
Highway 21	47	.28	.01	.71	25	.24	.03	.71
Paynton Ferry	30	.15	.03	.57	30	.15	.03	.57
Highway 16	68	.28	.01	1.0	35	.29	.03	1.0
Highway 4	35	.25	.03	1.2	35	.25	.03	1.2
Highway 376	51	.23	.02	.70	32	.18	.03	0.7
Borden Bridge	111	.29	.02	5.2	60	.31	.03	5.2
Highway 12	34	.28	.02	.90	14	.13	.03	.44
Wingard Ferry	15	.29	.03	.90	10	.11	.03	.57
Crutwell Ferry	15	.39	.03	1.1	15	.39	.03	1.1
P.A. WTP	156	.30	.02	1.2	16	.35	.03	.81
PAPCO	138	.33	.02	3.2	19	.50	.03	1.1
Cecil Ferry N	163	.40	.02	17	21	.43	.03	1.2
Cecil Ferry S	162	.31	.01	1.3	21	.38	.03	1.0
Cole Rapids	113	.27	.02	.98	27	.33	.03	.98

SSWQ Obj: not established

n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective

TABLE 3.1.9

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Ammonia Nitrogen (mg/L)

Period:

	1970 - 1982				1981-1982			
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	70	.25	.01	1.2	38	.08	.01	.45
Highway 3	62	.23	.01	1.1	28	.08	.01	.36
Highway 21	45	.22	.01	1.2	22	.10	.01	.38
Paynton Ferry	27	.10	.01	.72	27	.10	.01	.72
Highway 16	65	.67	.01	.31	30	.07	.01	.36
Highway 4	31	.07	.01	.35	31	.07	.01	.35
Highway 376	47	.17	.01	.82	27	.09	.01	.45
Borden Bridge	113	.16	.01	1.2	56	.06	.01	.38
Highway 12	35	.25	.01	.84	14	.05	.01	.22
Wingard Ferry	16	.27	.01	.92	10	.03	.01	.06
Crutwell Ferry	15	.06	.01	.24	15	.06	.01	.24
P.A. WTP	158	.47	.01	21	16	.50	.01	6.2
PAPCO	156	.35	.01	2.2	19	.13	.01	.33
Cecil Ferry N	182	.39	.01	1.6	21	.11	.01	.38
Cecil Ferry S	180	.37	.01	1.6	21	.12	.01	.35
Cole Rapids	121	.24	.01	.99	27	.07	.01	.32

SSWQ Obj: not established

Table 3.1.10

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Total Kjeldahl Nitrogen (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster			1.2	2.3	1.1	0.8	1.6	0.4	0.6	0.8	0.8	0.6	0.8
Highway 3		1.7	1.2	1.2	0.9	1.4	1.4	0.5	0.6	0.9	0.7	0.6	0.9
Highway 21				0.8	1.1	1.0	1.7	0.8	0.7		0.7	0.6	0.8
Paynton Ferry												0.6	0.8
Highway 16			0.9	1.1	1.7	1.3	1.7	0.7	0.6	1.3	0.6	0.8	0.8
Highway 4												0.9	0.8
Highway 376				1.1	1.2	1.7	1.7	0.3	0.4		0.7	0.7	0.8
Borden Bridge		0.8	1.2	0.8	1.5	1.0	1.3	0.8	0.6	0.9	0.8	0.6	0.7
Highway 12		1.3	1.3	1.6	1.2	1.6	1.4	0.6	0.5		0.9	0.9	1.0
Wingard Ferry		1.6	1.8				1.2		0.4				0.8
Crutwell Ferry													0.8
P.A. WTP		0.2	0.4	0.3	0.3	0.5	0.2	0.3	0.4	0.3	0.1	0.7	1.0
PAPCO		1.1	1.1	1.5	1.4	1.4	1.7	0.5	0.7	0.7	0.9	0.4	1.2
Cecil Ferry N		1.6	1.4	2.0	2.0	1.5	1.7	0.7	0.9	0.8	0.9	0.6	1.0
Cecil Ferry S		0.9	1.2	1.4	1.4	1.2	1.4	0.6	0.9	0.6	0.8	0.5	1.2
Cole Rapids			0.7	1.1	1.3	1.2	1.3	0.6	0.7	0.6	2.0	0.6	1.0

SSWQ Obj: 1.0 mg/L as total nitrogen (inorganic plus organic)

Table 3.1.11

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Nitrate - Nitrogen (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster			0.3	0.3	0.3	0.3	0.5	0.4	0.5	.04	0.3	0.1	0.3
Highway 3			0.6	0.3	0.3	0.3	0.3	0.3	0.5	0.3	0.4	0.2	0.3
Highway 21		0.5		0.3	0.2	0.3	0.5	0.3	0.5		0.4	0.2	0.3
Paynton Ferry												0.1	0.2
Highway 16		0.3	0.3	0.3	0.2	0.2	0.4	0.1	0.3	0.3	0.3	0.4	0.2
Highway 4												0.4	0.2
Highway 376		0.6		0.4	0.2	0.3	0.5	0.2	0.5		0.2	0.2	0.2
Borden Bridge		0.5	0.5	0.3	0.3	0.2	0.4	0.2	0.3	0.3	0.2	0.2	0.3
Highway 12		0.5	0.7	0.4	0.1	0.2	0.5	0.7	0.4		0.1	0.1	0.1
Wingard Ferry		0.6	0.7				0.4		0.8				0.1
Crutwell Ferry													0.4
P.A. WTP		0.2	0.4	0.3	0.3	0.5	0.2	0.3	0.4	0.3	0.1	0.3	0.4
PAPCO		0.1	0.4	0.4	0.3	0.4	0.1	0.2	0.4	0.5	0.1	0.3	0.6
Cecil Ferry N		0.1	0.3	1.3	0.3	0.4	0.2	0.2	0.3	0.3	0.2	0.4	0.4
Cecil Ferry S		0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3
Cole Rapids		0.5	0.2	0.3	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.3	0.3

SSWQ Obj: not established

Table 3.1.12

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Ammonia - Nitrogen (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster		1.2	0.6	0.3	0.5	0.2	0.9	0.1	0.4	0.5	0.1	0.1	0.1
Highway 3		1.0		0.2	0.4	0.4	0.6	0.1	0.3	0.4	0.1	0.1	0.1
Highway 21		1.1		0.4	0.3	0.1	0.7	0.1	0.3		0.1	0.1	0.1
Paynton Ferry												0.1	0.1
Highway 16		0.7	0.6	0.3	0.1	0.3	0.6	0.3	0.1	0.3	0.1	0.4	0.1
Highway 4												0.4	0.1
Highway 376		0.6		0.4	0.2	0.1	0.7	0.1	0.3		0.1	0.1	0.1
Borden Bridge	0.7	0.8	0.5	0.2	0.3	0.1	0.5	.04	0.2	.07	0.1	.04	0.1
Highway 12		0.8	0.5	0.5	.03	0.1	0.7	.03	0.4		0.1	0.1	.04
Wingard Ferry		0.7	0.8				0.9		0.2				0.3
Crutwell Ferry													0.1
P.A. WTP		0.4	0.5	0.3	0.4	0.3	0.6	0.1	0.1	0.1	1.8	0.7	0.2
PAPCO	0.4	0.6	0.5	0.4	0.4	0.3	0.6	.05	0.1	.02	.03	0.1	0.1
Cecil Ferry N	0.5	0.6	0.6	0.4	0.5	0.4	0.6	0.1	0.1	0.1	0.1	0.1	0.1
Cecil Ferry S	0.5	0.6	0.5	0.4	0.4	0.3	0.6	0.2	0.1	0.1	0.1	0.1	0.1
Cole Rapids		0.5	0.3	0.4	0.3	0.2	0.6	.05	0.1	0.1	.05	.05	0.1

SSWQ Obj: not established

during the winter seasons. Winter mean levels of nitrate and ammonia nitrogen were generally greater by a factor of 2 or more than corresponding levels recorded for the spring/summer and fall seasons.

The observation of increased levels of nitrate and ammonia nitrogen during winter is a phenomenon common to rivers in areas of temperate climate. In the North Saskatchewan River nitrate-nitrogen levels would be expected to increase during the winter because of reduced uptake of nitrate by plants, benthic algae and microorganisms under the low water temperature (Table A4.2) and ice cover conditions associated with winter, and because of less dilution under winter low flow conditions (e.g. Figure 1.1).

Ammonia-nitrogen may be of significance to water quality because high levels of unionized ammonia (e.g. NH_3) may be toxic to fish, and because it exerts a nitrogenous oxygen demand during its oxidation to nitrite (NO_2^-) and nitrate (NO_3^-) by nitrifying microorganisms.

The proportion of ammonia-nitrogen present in water as unionized ammonia is usually very small and is influenced mostly by water temperature, pH and TDS (Messer, Ho and Grenney 1984). The proportion of unionized ammonia present increases with increases in water temperature or pH but tends to be decreased in waters with high levels of TDS.

In the North Saskatchewan River, generally higher mean ammonia-nitrogen levels were recorded for the winter period (Table A4.8) than in other seasons. However, at the lower temperatures (Table A4.3), and generally lower pH occuring in winter (Table A4.11) probably less than 0.26 per cent of the ammonia-nitrogen present would be in the form of unionized ammonia according to United States Environmental Protection Agency draft criteria (USEPA 1983). Based upon these criteria the maximum ammonia-nitrogen level of 6.2 mg/L observed in an individual sample during the winter in the North Saskatchewan River (Table A4.8, 1981-1982 data) would be associated with an unionized ammonia nitrogen concentration of about 0.016 mg/L. Under the winter temperature and pH conditions recorded for the river in 1981-1982 this maximum level of unionized ammonia nitrogen would be considerably less than the maximum allowable level (e.g. 0.033 mg/L) for individual samples suggested in the USEPA (1983) criteria. The mean levels of ammonia nitrogen, however, were generally much lower than this maximum value suggesting that winter unionized ammonia levels in the river would not pose any threat to aquatic biota. The relatively high TDS levels during the winter (Table A4.14) would further decrease the levels of unionized ammonia present in the river.

During the spring/summer periods of 1981-1982 the maximum level of ammonia nitrogen observed in an individual sample from the river was 0.38 mg/L (Table A4.8). Had this maximum level occurred concurrently with the spring/summer maxima for water temperature (e.g. 26°C, Table A4.3) and pH (9.1, Table A4.11) approximately 16 per cent of the ammonia nitrogen would have been present as unionized ammonia (e.g. 0.06 mg/L). The USEPA (1983) criteria suggest a maximum allowable unionized ammonia concentration of about 0.12 mg/L and a maximum allowable total ammonia nitrogen level of about 0.34 mg/L for waters at this temperature and pH. This indicates that the ammonia nitrogen and unionized ammonia nitrogen present in the North Saskatchewan River was consistently below the maximum allowable levels suggested by the USEPA (1983) criteria for individual samples.

Additional criteria have also been proposed by the USEPA (1983) concerning 30-day average allowable unionized ammonia and ammonia nitrogen levels in water. These criteria generally involve much lower allowable levels of these constituents than are suggested for individual sample results. Further monitoring of the North Saskatchewan River for ammonia-nitrogen is recommended in order to acquire a data base sufficient to determine 30-day average levels of these variables. This monitoring should include the collection of at least five samples over a 30-day period during summer (eg. July/August) at sites where elevated levels of ammonia-nitrogen have been observed in the past (eg. PAWTP, Cecil Ferry north and south, Table 3.1.9). The samples should be analysed for ammonia-nitrogen as well as for variables which may significantly influence the concentration of unionized-ammonia present (eg. pH, water temperature, TDS). Sample preservation should be carried out if rapid ammonia-nitrogen analyses cannot be assured.

Surface water quality objectives for Saskatchewan for ammonia nitrogen and unionized ammonia have not yet been established.

In winter ammonia nitrogen levels increase due to reduced uptake of ammonia nitrogen by algae and microorganisms, reduced activity by aquatic nitrifying microorganisms which convert ammonia nitrogen to nitrite and nitrate nitrogen, decreased losses of ammonia to the atmosphere because of ice cover, and less dilution of ammonia, released through microbial decay of nitrogenous organic matter and that added to the river through wastewater discharge, under the winter low flow conditions.

3.1.3.2 Phosphorus

Phosphorus is an important water quality variable since it is of major significance in controlling the growth of aquatic plants and algae. Large quantities of phosphorus in a form unavailable to plants or microbes may be associated with the bottom and suspended sediments of rivers. Of greater concern to water quality is phosphorus which is added to or present in water either as phosphorus incorporated in living or dead plant and animal material or as dissolved inorganic forms such as ortho phosphate, which may be directly utilized for plant growth. The levels of biologically available dissolved phosphorus in surface waters, however, are generally very low because it is rapidly utilized by aquatic plants, or absorbed by sediments.

In Saskatchewan monitoring of total phosphorus (total organic plus inorganic phosphorus) and dissolved ortho phosphorus has been conducted at stations on the North Saskatchewan River since 1970. The current provincial surface water quality objective pertains to total phosphorus (0.05 mg/L), but, as is the case with total nitrogen, the objective may not be achievable in some naturally nutrient-enriched waters common to the prairie environment.

Summaries of long-term mean, minimum and maximum values for total phosphorus and for dissolved ortho phosphorus are presented in Table 3.1.13. A summary of annual mean data for total phosphorus

TABLE 3.1.13
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Phosphorus

Period:

		1970 - 1982				1981-1982		
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	73	.14	.01	.85	41	.18	.06	.85
Highway 3	65	.14	.01	.80	31	.20	.05	.80
Highway 21	48	.16	.01	1.2	25	.21	.07	1.2
Paynton Ferry	30	.19	.07	1.8	30	.19	.07	1.8
Highway 16	70	.30	.01	.11	35	.22	.07	.55
Highway 4	35	.62	.06	.14	35	.62	.06	.14
Highway 376	52	.18	.02	1.2	32	.24	.08	1.2
Borden Bridge	116	.14	.01	1.9	60	.14	.04	.60
Highway 12	35	.13	.01	.60	14	.04	.02	.60
Wingard Ferry	16	.10	.02	.19	10	.11	.06	.19
Crutwell Ferry	15	.20	.06	.55	15	.20	.06	.55
P.A. WTP	157	.10	.01	2.6	16	.29	.04	2.6
PAPCO	157	.10	.00	.62	19	.21	.06	.28
Cecil Ferry N	181	.10	.01	.50	20	.14	.06	.62
Cecil Ferry S	179	.10	.01	.70	21	.18	.06	.70
Cole Rapids	120	.11	.00	.61	27	.19	.06	.61

SSWQ Obj: 0.05 mg/L as P

Variable: Ortho Phosphorus (mg/L) - dissolved

Period:

		1970 - 1982				1981-1982		
	n	MEAN	MIN.	MAX.	n	MEAN	MIN.	MAX.
Lloydminster	71	.06	.01	.70	42	.08	.01	.70
Highway 3	61	.05	.01	.22	31	.06	.01	.22
Highway 21	46	.06	.01	.25	25	.07	.01	.25
Paynton Ferry	30	.05	.01	.22	30	.05	.01	.22
Highway 16	65	.12	.00	5.4	33	.05	.01	.15
Highway 4	33	.04	.01	.19	33	.04	.01	.19
Highway 376	47	.05	.01	.24	30	.05	.01	.24
Borden Bridge	112	.04	.00	.18	58	.04	.01	.17
Highway 12	32	.03	.01	.09	14	.03	.01	.06
Wingard Ferry	16	.03	.01	.10	10	.02	.01	.05
Crutwell Ferry	15	.03	.01	.06	15	.03	.01	.06
P.A. WTP	156	.05	.00	1.8	16	.11	.01	.90
PAPCO	155	.03	.00	.20	19	.07	.01	.15
Cecil Ferry N	182	.04	.00	.38	21	.07	.01	.38
Cecil Ferry S	178	.03	.00	.14	21	.06	.01	.14
Cole Rapids	121	.03	.00	.14	27	.05	.01	.14

SSWQ Obj: Not established.

n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective

Table 3.1.14

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Total Phosphorus (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster	-	.11	.05	.08	.03	.06	.04	.14	.13	.13	.25	.04	.10
Highway 3	-	.13	-	.07	.04	.04	.03	.21	.11	.16	.15	.17	.22
Highway 21	-	.11	-	.09	.02	.04	.04	.13	.13	-	.21	.24	.19
Paynton Ferry	-	-	-	-	-	-	-	-	-	-	-	.23	.15
Highway 16	-	.06	.07	.05	.03	.04	.04	.16	.13	.19	.14	.29	.15
Highway 4	-	-	-	-	-	-	-	-	-	-	-	.36	.15
Highway 376	-	.08	-	.06	.03	.03	.04	.11	.11	-	.20	.06	.11
Borden Bridge	.12	.09	.09	.04	.06	.03	.03	.15	.16	.31	.13	.17	.13
Highway 12	-	.05	.10	.05	.03	.03	.04	.05	.11	-	.16	.24	.21
Wingard Ferry	-	.06	.08	-	-	-	.06	-	.07	-	-	-	.11
Crutwell Ferry	-	-	-	-	-	-	-	-	-	-	-	-	.20
P.A. WTP	-	.06	.10	.09	.04	.04	.03	.11	.10	.10	.16	.39	.12
PAPCO	.03	.10	.09	.08	.04	.07	.04	.15	.13	.14	.14	.09	.26
Cecil Ferry N	.06	.11	.12	.09	.04	.04	.10	.09	.18	.10	.13	.14	.14
Cecil Ferry S	.15	.12	.10	.09	.03	.04	.05	.12	.14	.09	.10	.13	.22
Cole Rapids	-	.09	.09	.06	.04	.04	.04	.18	.16	.09	.12	.15	.21

SSWQ Obj: 0.05 mg/L s P

Table 3.1.15

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Ortho Phosphorus (mg/L) - dissolved

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster	-	.11	.04	.04	.02	.01	.01	.03	.09	.10	.05	.04	.10
Highway 3	-	.13	-	.01	.02	.01	.01	.06	.07	.06	.07	.05	.08
Highway 21	-	.12	-	.03	.02	.03	-	.03	.07	-	.06	.06	.08
Paynton Ferry	-	-	-	-	-	-	-	-	-	-	-	.03	.06
Highway 16	-	.05	1.8	.02	.01	.01	.01	.03	.05	.04	.05	.05	.05
Highway 4	-	-	-	-	-	-	-	-	-	-	-	.04	.04
Highway 376	-	.07	-	.01	.01	.01	-	.02	.06	-	.08	.04	.06
Borden Bridge	.06	.07	.05	.02	.03	.01	.01	.03	.05	.04	.03	.04	.04
Highway 12	-	.05	.06	.03	.01	.01	.01	.06	.08	.01	.04	.04	.03
Wingard Ferry	-	.06	.05	-	-	-	.03	-	.07	-	-	-	.02
Crutwell Ferry	-	-	-	-	-	-	-	-	-	-	-	-	.03
P.A. WTP	-	.02	.04	.03	.01	.02	.01	.03	.04	.04	.19	.13	.08
PAPCO	.01	.03	.04	.02	.02	.03	.01	.02	.05	.02	.02	.05	.07
Cecil Ferry N	.03	.03	.04	.03	.02	.03	.03	.02	.05	.04	.02	.04	.08
Cecil Ferry S	.04	.04	.04	.03	.02	.02	.02	.02	.05	.03	.03	.05	.06
Cole Rapids	-	.03	.02	.03	.02	.02	.01	.03	.05	.03	.03	.05	.04

SSWQ Obj: not established

for each sampling station on the North Saskatchewan River is presented in Table 3.1.14. Annual mean data for ortho phosphorus are recorded in Table 3.1.15.

Seasonal mean data concerning total and ortho phosphorus for the periods 1970-1982 and 1981-1982 are recorded in Tables A4.9 and A4.10 of Appendix 4, respectively.

Although individual values for total phosphorus concentration at the various sampling sites between 1970 and 1982 were quite variable (range 0.01-2.6 mg/L) the long-term mean values for this variable ranged from 0.10 to 0.62 mg/L within the river reach examined (Table 3.1.13). The long-term mean values showed a trend towards lower levels of total phosphorus in the river reach below Prince Albert compared to the upper reach for the 1970-1982 period. This trend was not apparent for data concerning the 1981-1982 period in which mean values were relatively uniform from the border (Lloydminster ferry) to Cole Rapids. In this period mean values for total phosphorus in the lower river reach were approximately twice those recorded for the 1970-1982 period. As shown in Table 3.1.14 generally higher mean values for this variable were recorded for all monitoring sites from 1977 to 1982. The general increase in recorded levels of total phosphorus are believed to relate mostly to changes in the analytical procedure for this variable implemented at the Provincial Laboratories late in 1976.

It is apparent from these data that long-term (Table 3.1.13) and annual mean (Table 3.1.14) values for total phosphorus at each monitoring station generally exceeded the existing surface water quality objective of 0.05 mg/L. Such observations, however, are commonly made with regard to surface waters in the southern half of the province owing to naturally high levels of phosphorus in the water. On the basis of these data there is little indication of significant increases in phosphorus levels near any particular monitoring station that might be related to effluent discharges.

With few exceptions, annual mean values for total phosphorus near the Alberta-Saskatchewan border (e.g. 1981, 1982 Table 3.1.14) were generally similar to those recorded for most stations downstream. The mean value for total phosphorus at the provincial border for the period 1977-1981 was reported by Alberta Environment (1983) as 0.11 mg/L. This is within the range of annual mean values (0.04-0.25 mg/L) recorded for the border area of the river for the same period in the present study (Table 3.1.14). Because of the change in analytical procedures for this variable in 1976 it is not possible to determine if significant temporal trends in total phosphorus levels in the river reach in Saskatchewan have occurred. These data did not indicate any significant influences of major effluent sources upon total phosphorus levels in the river.

The mean dissolved ortho phosphorus concentration reported by Alberta Environment (1983) for the river near the Alberta-Saskatchewan border for the period 1970-1977 was 0.10 mg/L. Among data obtained by Saskatchewan Environment for the same period for the border monitoring site (Lloydminster ferry) the annual mean dissolved ortho phosphorus levels ranged from 0.01 to 0.11 mg/L (Table 3.1.15). The long-term mean values for this variable at the Lloydminster ferry station for the 1970-1982 and 1981-1982 periods were 0.06 and 0.08 mg/L, respectively. The mean value for ortho phosphorus concentration reported by the Prairie Provinces Water Board for the 1974 to 1982 period for its border monitoring site (Highway 3) was 0.05 mg/L (PPWB 1983) indicating that similar results were obtained by three monitoring agencies with respect to this variable.

The long-term mean values for dissolved ortho phosphorus (Table 3.1.13) during the period 1970-1982 ranged from 0.03 to 0.12 mg/L at the 16 monitoring stations. Among this data a general trend towards decreased levels of ortho phosphorus in a downstream direction is apparent from the provincial border area (Lloydminster ferry), where water entering the province had a mean concentration of 0.06 mg/L ortho phosphorus, to Cole Rapids at 0.03 mg/L. The exception to this trend was recorded at the Highway 16 monitoring station where the long-term mean value was 0.12 mg/L. Among annual mean data (Table 3.1.15) this trend towards lower concentrations of ortho phosphorus occurring at stations in a downstream direction is also apparent for some years (e.g. 1971, 1973, 1978-1980) during the 1970-1982 period.

Ortho phosphorus data for the entire river reach obtained since 1977 also showed an increase in annual mean values compared to those determined between 1970 and 1976 at all stations (Table 3.1.15). Again, this is believed to be related mainly to changes in analytical procedures implemented late in 1976. Generally higher annual mean levels of ortho phosphorus were recorded for most stations, particularly in the lower river reach, during 1982 than in previous years.

This observation, however, may be the result of natural variation in nutrient levels experienced from year to year in most water bodies.

Seasonal mean data concerning total phosphorus and dissolved ortho phosphorus levels in the river at various sampling sites between 1970 and 1982 are recorded in Tables A4.9 and A4.10, respectively.

There were distinct seasonal patterns in the levels and forms of phosphorus present at various sites along the North Saskatchewan River between 1970 and 1982. Among the long-term seasonal mean data for total phosphorus (Table A4.9) generally higher values are apparent for all monitoring sites during the spring/summer season. Mean total phosphorus levels ranged from 0.11 to 0.82 mg/L during the spring/summer season during the 1970-1982 period as a whole. Mean levels of this variable during the same period ranged from 0.08 to 0.19 mg/L in winter and 0.7 to 0.56 mg/L in fall. A similar seasonal trend is apparent for data concerning the 1981-1982 period although mean levels were generally greater than those observed during the 1970-1982 period as a whole because of the influence of analytical procedure changes implemented in 1976 lending a bias to higher values in years from 1977 to 1982, as discussed above.

Generally higher levels of total phosphorus during the spring/summer season in the river are expected due to the likely presence of greater quantities of algae in the summer portion of this period and to increased levels of phosphorus containing organic and inorganic (sediment) debris suspended in the water column under the high flow conditions occurring during spring/summer (e.g. Figure 1.2). Conversely, the highest mean levels of dissolved ortho phosphorus were observed at most monitoring sites during the winter season (Table A4.10). In winter low temperatures and ice cover reduce plant growth and uptake of ortho phosphorus while concurrent decomposition of plant and animal debris from the previous growing season release additional dissolved phosphorus to the water column. The mean levels of ortho phoshporus observed in the spring/summer season at most stations tended to be similar to those observed at most sampling sites during the fall season. This trend may not be unusual, however, since the expected decrease in levels of ortho phosphorus in spring and summer due to uptake of ortho phosphorus by plants, microbes, and algae was likely offset by contributions of this variable in runoff water from the watershed in spring and transport of additional ortho phosphorus during the high flow periods of spring and summer on the North Saskatchewan River (Figure 1.2).

The relatively high mean levels of dissolved ortho phosphorus present in the river water even during the growing season (spring/summer) suggests that phosphorus is not a nutrient limiting algal and plant growth in the North Saskatchewan River.

Similar seasonal trends in levels of total and ortho phosphorus were reported by Alberta Environment (1983).

3.2 Bacteriology

3.2.1 Background Discussion

In Saskatchewan the bacteriological quality of surface water is assessed using various objectives for the indicator bacteria total coliforms (TC) and fecal coliforms (FC). These bacteriological surface water quality objectives are as follows: (Saskatchewan Environment, 1975).

(a) In waters to be withdrawn for treatment and distribution as a potable supply or used for outdoor recreation other than direct contact, at least 90 per cent of the samples (not less than five samples in any consecutive 30 day period) should have a TC density of less than 5,000 per 100 mL and a FC density of less than 1,000 per 100 mL. (The Maximum Permissible Limit of TC organisms in a single sample shall be determined by the department based on the type and degree of pollution and other local conditions existing within the watershed.)

(b) In waters used for direct contact recreation or vegetable crop irrigation the geometric mean of not less than five samples taken over not more than a 30 day period should not exceed 1,000 per 100 mL TC nor 200 per 100 mL FC, nor exceed these numbers in more than 20 per cent of the samples examined during any month, nor exceed 2,400 per 100 mL total coliforms on any day.

At present Saskatchewan does not have a surface water quality objective concerning the fecal streptococci (FS) indicator group, but analyses for these bacteria are routinely conducted on surface water samples to provide additional information about the origins and significance of perceived fecal pollution that may be suggested by high levels of the other indicator bacterial groups, TC and FC.

These indicator bacteria groups have been the subject of considerable discussion because of inherent difficulties in the standard analytical procedures used for their enumeration. It is beyond the scope of this report to extensively review the literature pertaining to the deficiencies in the indicator concepts and test procedures, but attention will be drawn to specific shortcomings as they relate to water quality assessment of the North Saskatchewan River.

Total coliforms (TC) are arbitrarily defined as bacteria which grow and produce specific biochemical reactions on or in defined growth media at 35°C. They are comprised mainly of species of the enteric genera Escherichia, Klebsiella, Citrobacter, and Enterobacter. While species of Escherichia (e.g. E. coli.) are believed to be restricted in origin to the intestinal tract of warm-blooded animals, species of the other genera may be derived from various sources such as soil and vegetation as well as from human and animal feces. Their presence at high levels in a surface water is indicative of poor water quality although their presence may not necessarily relate to fecal pollution or the probable presence of pathogenic bacteria.

Fecal coliform (FC) bacteria may be considered a subset of the TC population and are generally considered to be comprised of species of Escherichia and to a lesser extent, Klebsiella. They too are arbitrarily defined on the basis of biochemical reactions on or in defined media incubated at an elevated temperature (e.g. 44.5°C). Their presence in water are generally considered as indicative of recent contamination by fecal material and of the potential presence of pathogenic bacteria, most notably the salmonellae.

The fecal streptococci (FS) indicator group is comprised of several species of the genus Streptococcus which inhabit the intestinal tracts of humans and warm blooded animals. Generally FS are present in the feces of animals (e.g. cattle, poultry, pets, rodents) at higher densities than are members of the FC group. Their relative abundance in a water body compared to that of FC has been employed to determine the relative contributions of human or animal fecal material (e.g. the FC/FS ratio). However, as is the case with TC and FC, contributions of FS from diffuse sources such as soil, and plant debris can alter the numerical relationship between FC and FS which may sometimes be observed in feces or untreated sewage. Also, due to differential rates of die-off in water and to possible growth of some FC strains in water, the FC/FS ratio is of very limited usefulness in describing the origins of perceived fecal contamination in surface waters. Nevertheless the detection of FS at high levels is usually indicative of a fecal contribution to a surface water and their concurrent determination with the FC group provides supportive evidence of the fecal origin of the FC that may be detected. Unlike the coliform groups, species of the FS group are not considered capable of growth in aquatic environments under normal conditions.

This subject is given more detailed consideration in another report concerning a study of the water quality of the North Saskatchewan River near Prince Albert (Saskatchewan Environment, 1984).

3.2.2 Survey Results and Discussion

Summaries of long-term geometric mean (GM), minimum and maximum values for total coliform (TC), fecal coliform (FC), and fecal streptococcus (FS) results at various sampling sites during the 1970-1982 and 1981-1982 periods are presented in Tables 3.2.1, 3.2.2 and 3.2.3, respectively. Detailed data concerning the results of analyses of individual water samples for TC, FC, and FS are recorded on the ESQUADAT computer system and are available upon request. For the TC and FC variables, the results of two procedures used for analyses have been presented separately in the above-mentioned tables.

The long-term GM values for the TC variable determined by both the membrane filtration (MF) and most probable number (MPN) procedures are shown in Table 3.2.1. These results indicate that the long-term GM levels of TC bacteria at all stations from the provincial border near the Lloydminster ferry crossing to the Prince Albert Pulp Company (PAPCO) water intake were less than 1,000 TC per 100 mL (range GM 46 to 897 TC per 100 mL). Alberta Environment (1983) reported a mean value of 253 TC per 100 mL (MPN) at the provincial border for the period 1970-1977 and 150 TC per 100 mL for the period 1977-1981.

These results suggest that the bacteriological quality of the river water from the provincial border to PAPCO is satisfactory for all water uses (e.g. recreational, irrigational, domestic supply after treatment) addressed in the existing provincial surface water quality objectives (Saskatchewan Environment, 1975). However, at most of the stations within this river reach individual maximum values for TC bacteria have at least periodically exceeded the maximum acceptable levels for TC considered in the surface water quality objectives pertaining to the above-mentioned water use categories.

TABLE 3.2.1
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total coliforms (count per 100 mL - MF)

Period:		1970 - 1982				1981-1982		
	n	GM	MIN.	MAX.	n	GM	MIN.	MAX.
Lloydminster	15	267	60	15,000	15	267	60	15,000
Highway 3	23	258	40	30,000	17	226	40	G30,000
Highway 21	14	143	10	1,400	14	143	10	1,400
Paynton Ferry	15	66	L10	300	15	66	L10	300
Highway 16	25	162	L10	3,000	18	135	L10	1,300
Highway 4	14	84	10	900	14	84	10	900
Highway 376	15	111	10	1,000	15	111	10	1,000
Borden Bridge	44	215	10	G10,000	35	194	L10	G10,000
Highway 12	9	46	L10	L100	9	46	L10	L100
Wingard Ferry	9	87	L10	G3,000	9	87	L10	G3,000
Crutwell Ferry	9	46	L10	L100	9	46	L10	L100
P.A. WTP	62	284	24	G10,000	15	382	L100	G10,000
PAPCO	42	897	L100	G10,000	11	927	L100	G10,000
Cecil Ferry N	34	4,440	13	61,000	11	6,510	200	61,000
Cecil Ferry S	28	11,800	G3,000	94,000	11	9,970	G3,000	G30,000
Cole Rapids	65	7,075	400	84,000	22	5,970	400	30,000

SSWQ Obj: See Section 3.2.1

Variable: Total coliforms (count per 100 mL - MPN)

Period:		1970 - 1982				1981-1982		
	n	GM	MIN.	MAX.	n	GM	MIN.	MAX.
Lloydminster	34	306	L23	24,000	3	73	L23	430
Highway 3	28	133	L23	2,400	0	-	-	-
Highway 21	25	175	L23	9,300	3	57	L23	90
Paynton Ferry	0	-	-	-	0	-	-	-
Highway 16	26	96	L23	24,000	0	-	-	-
Highway 4	4	59	L30	150	4	59	L30	150
Highway 376	22	166	L23	460,000	4	2,030	200	460,000
Borden Bridge	44	183	L23	11,000	0	-	-	-
Highway 12	21	110	L23	430	3	128	40	230
Wingard Ferry	6	85	L23	230	0	-	-	-
Crutwell Ferry	6	158	L23	4,300	6	158	L23	4,300
P.A. WTP	113	242	10	28,000	0	-	-	-
PAPCO	128	666	L10	93,000	6	4,160	230	93,000
Cecil Ferry N	172	8,410	L23	930,000	11	1,730	40	21,000
Cecil Ferry S	175	11,300	L23	460,000	12	14,300	930	46,000
Cole Rapids	184	11,800	90	750,000	6	11,700	4,300	43,000

SSWQ Obj: See Section 3.2.1

n = number of samples MIN = Minimum MAX = Maximum L = less than
G = greater than GM = geometric mean MF = membrane filtration
analyses MPN = most probable number analyses
SSWQ Obj = Saskatchewan Surface Water Quality Objective

TABLE 3.2.2
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Fecal coliforms (count per 100 mL - MF)

Period:	1970 - 1982				1981-1982			
	n	GM	MIN.	MAX.	n	GM	MIN.	MAX.
Lloydminster	15	13	L2	120	15	13	L2	120
Highway 3	24	15	L1	300	17	12	L2	150
Highway 21	14	11	L2	L60	14	11	L2	L60
Paynton Ferry	15	8	L1	70	15	8	L1	70
Highway 16	28	14	L1	800	19	13	L1	800
Highway 4	14	9	1	600	14	9	1	600
Highway 376	15	11	L2	170	15	11	L2	170
Borden Bridge	43	24	1	500	35	23	1	500
Highway 12	9	5	1	20	9	5	1	20
Wingard Ferry	9	5	L1	L10	9	5	L1	L10
Crutwell Ferry	9	6	L1	L10	9	6	L1	L10
P.A. WTP	63	20	L1	G24,000	15	31	L10	1,200
PAPCO	43	38	5	G1,000	11	58	L10	400
Cecil Ferry N	32	108	L1	23,000	10	108	L1	23,000
Cecil Ferry S	29	1,630	40	16,000	11	1,060	160	G3,000
Cole Rapids	33	497	L10	G10,000	19	631	100	G3,000

SSWQ Obj: See Section 3.2.1

Variable: Fecal Coliforms (count per 100 mL - MPN)

Period:	1970 - 1982				1981 - 1982			
	n	GM	MIN.	MAX.	n	GM	MIN.	MAX.
Lloydminster	33	83	L1	2,400	3	25	L23	30
Highway 3	26	65	L1	2,400	0	-	-	-
Highway 21	24	55	L1	1,500	3	23	L23	L23
Paynton Ferry	0	-	-	-	0	-	-	-
Highway 16	24	41	1	1,500	0	-	-	-
Highway 4	4	35	L30	L30	4	35	L30	L30
Highway 376	21	63	L1	93,000	4	412	L23	93,000
Borden Bridge	43	64	5	2,400	0	-	-	-
Highway 12	20	41	14	230	3	44	L23	90
Wingard Ferry	5	63	L23	230	0	-	-	-
Crutwell Ferry	6	59	L23	150	6	59	L23	150
P.A. WTP	108	85	L10	G24,000	0	-	-	-
PAPCO	118	193	L10	43,000	6	538	40	23,000
Cecil Ferry N	157	965	10	930,000	11	147	L23	2,300
Cecil Ferry S	161	2,620	L23	430,000	12	1,490	120	23,000
Cole Rapids	81	2,380	L23	240,000	6	2,340	750	9,300

SSWQ Obj: See Section 3.2.1

n = number of samples MIN = Minimum MAX = Maximum L = less than
G = greater than GM = geometric mean MF = membrane filtration
analyses MPN = most probable number analyses
SSWQ Obj = Saskatchewan Surface Water Quality Objective

TABLE 3.2.3
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Fecal Streptococci (counter per 100 mL - MF)

Period:	1970 - 1982				1981-1982			
	n	GM	MIN.	MAX.	n	GM	MIN.	MAX.
Lloydminster	15	14	L2	200	15	14	L2	200
Highway 3	29	11	L1	300	17	15	2	300
Highway 21	14	13	2	40	14	13	2	40
Paynton Ferry	15	7	2	40	15	7	1	40
Highway 16	30	13	L1	210	19	14	1	210
Highway 4	14	12	L2	150	14	12	L2	150
Highway 376	15	10	L2	70	15	10	L2	70
Borden Bridge	44	20	1	330	35	21	1	330
Highway 12	9	8	L1	50	9	8	L1	50
Wingard Ferry	9	5	L1	20	9	5	L1	20
Crutwell Ferry	9	5	1	L10	9	5	1	L10
P.A. WTP	73	17	L1	1,200	14	31	L10	G1,000
PAPCO	48	18	L1	G1,000	10	18	L10	80
Cecil Ferry N	40	19	1	2,000	9	21	8	120
Cecil Ferry S	27	123	10	1,600	9	98	10	460
Cole Rapids	69	75	4	1,600	21	109	10	G1,000

SSWQ Obj: not established, see Section 3.2.1

n = number of samples MIN = Minimum MAX = Maximum L = less than
G = greater than GM = geometric mean MF = membrane filtration analyses
SSWQ Obj = Saskatchewan Surface Water Quality Objective

It should also be noted that within this river reach the bacteriological water quality reported for the PAPCO water intake area (station 42, Table 2.1) may not adequately characterize the quality of the entire river width at this location since most of the data since 1970 concerned samples obtained from the north shore of the river at the water intake. In an intensive study of the river water quality conducted in fall of 1983 bacteriological data was obtained for five sites along a transect at this station. The bacteriological quality of the southern three-quarters of the river width was shown to be adversely influenced by the plume of sewage effluent discharged to the southern shore of the river from the City of Prince Albert (Saskatchewan Environment, 1984). Water withdrawn from the river by PAPCO through the mill intake on the north shore of the river, however, was found to be satisfactory for all uses addressed in the current provincial surface water quality objectives (Saskatchewan Environment, 1975). Under the low flow conditions of the autumn 1983 study the sewage effluent plume was shown to have dispersed over the southern three-quarters of the river width after travelling approximately 8 kilometres from the sewage effluent outfall.

The long-term GM values for TC at the Cecil Ferry and Cole Rapids locations generally exceeded the surface water quality objectives pertaining to this variable for recreational, irrigational or water supply purposes. The relatively high levels of TC bacteria at these locations (range of GM 4,400 to 11,800 TC per 100 mL) are due to the combined effects of wastewater plumes from the City of Prince Albert sewage treatment plant and from the PAPCO pulp mill (Saskatchewan Environment, 1984).

GM levels of TC at most stations were similar for both the 1970-1982 and 1981-1982 periods indicating that levels of indicator bacteria in the river had not changed appreciably in recent years from those observed in the previous decade. With few exceptions the two methods of analyses for TC (MF and MPN) yielded very similar results for long-term GM levels of TC. Direct comparison of the results obtained by the two procedures, however, is difficult because only rarely were both used for concurrent analyses of samples.

Summaries of long-term GM values for FC bacteria for the two analytical procedures are presented in table 3.2.2. As was noted for long-term GM values for TC, those for FC (range 5 to 193 FC per 100 mL) at river monitoring sites upstream of Cecil Ferry were generally indicative of bacteriological quality suitable for all water uses addressed in the existing surface water quality objectives pertaining to this variable (Saskatchewan Environment, 1975). Also, as noted previously for the TC variables, individual values for FC bacteria periodically were much higher than the GM values for each site, as shown by the maxima recorded in Table 3.2.2. FC mean values reported by Alberta Environment (1983) for the 1970-1977 and 1977-1981 periods for the Alberta/Saskatchewan border area were 31 and 48 FC per 100 mL (MPN) respectively.

In the lower reach of the river, at Cecil Ferry and Cole Rapids considerably higher GM levels of FC were generally observed. GM values of MPN data were generally higher than those obtained when analyses was conducted by MF. This is especially apparent when maxima for stations in this lower reach are compared (Table 3.2.2).

The GM levels of FC determined by MF at the north and south sampling sites at Cecil Ferry and at Cole Rapids were 208, 1,630 and 497 FC per 100 mL, respectively. For these same sites the corresponding GM values obtained from MPN analysis were 965, 2,620 and 2,380 FC per 100 mL. These data, with the exception of MF data for Cecil Ferry north, indicate that the FC levels in this lower reach of the river generally exceeded the existing surface water quality objectives concerning contact recreation and use of river water for vegetable crop irrigation.

MF and MPN GM values for FC at Cecil Ferry South (2,620 FC per 100 ml) and that for MPN at Cole Rapids (2,380 FC per 100 ml) also exceed the surface water quality objective concerning use of the water for potable supply after treatment and for noncontact recreation (eg. 1,000 FC/100ml, Saskatchewan Environment 1975). However, use of the river water in this reach is apparently limited to noncontact recreation such as fishing, canoeing, and camping (Saskatchewan Environment 1984). The intensity of recreational use of the river in this reach is unknown. Future uses of the river in this reach and at more distant points downstream, and in the Saskatchewan River, however, might be impaired.

A summary of long-term GM levels of FS in the river at various sampling sites is presented in Table 3.2.3. All results shown are those obtained using MF analyses.

The long-term GM levels of FS at the various stations ranged from 5 to 123 per 100 ml, with the highest GM level (123 FS per 100 ml) being recorded for the Cecil Ferry south location. GM values for the 1981-1982 period differed little from those of the 1970-1982 period as a whole.

Although a surface water quality objective for FS has not been established for Saskatchewan routine monitoring of surface waters for this variable is conducted to aid in the interpretation of data concerning the other indicator bacteria (TC and FC) for which objectives have been prepared. On the North Saskatchewan River the GM levels of FS were relatively low except in the lower river reach in areas thought to be directly influenced by the sewage effluent plume originating near Prince Albert. The relatively higher GM level of FS on the southern half of the river at Cecil Ferry (123 FS per 100 ml) and at midstream at Cole Rapids was believed to be due to the influence of this sewage plume. Conversely, in the northern half of the river at Cecil Ferry the FS GM level was only 19 per 100 ml and this was understood to indicate that the high levels of indicator bacteria on the north side of the river might be due to sources other than fecal wastes. The intensive water quality investigation and related literature review concerning the bacteriological characteristics of pulp mill wastewater undertaken in autumn of 1983 (Saskatchewan Environment 1984) provided strong evidence in support of the non-fecal origin of the TC and FC indicator bacteria observed on the north side of the river at Cecil Ferry since FS were shown to be at negligible levels in the pulp mill effluent. However, since that study also showed that the municipal sewage effluent and pulp mill wastewater plumes begin to merge in the river reach above Cecil Ferry it is not possible to accurately determine quantitatively the contribution of each effluent to the observed high levels of bacteria at sites farther downstream.

In summary, the bacteriological GM data for TC and FC in the North Saskatchewan River for the 1970-1982 period generally indicated water quality to be suitable for use purposes addressed in the existing surface water quality objectives (Saskatchewan Environment 1975) from the Alberta/Saskatchewan border to the station at the PAPCO water intake. Periodically, higher levels of TC and FC in individual samples were observed, at most stations, which exceeded these objectives.

In the lower river reach, from Cecil Ferry to Cole Rapids, and beyond (Saskatchewan Environment 1984), the GM mean levels of TC and FC generally exceeded the maximum levels considered acceptable for most water uses addressed in the existing surface water quality objectives. However, current water usage in this lower river reach is believed to be limited to noncontact recreational activities. The apparent poor bacteriological water quality in this lower river reach is attributable to discharges of primary treated sewage effluent from the City of Prince Albert, and of treated pulp mill effluent. The water quality significance of FC contributed to the river through pulp mill effluent discharge, however, is uncertain because they are not thought to be of direct fecal origin. Another report considers the bacteriological quality of effluents and river water in this lower reach in much greater detail (Saskatchewan Environment 1984).

3.3 Inorganic Variables

3.3.1 pH

The pH of water provides an indication of the balance between acids and bases and is a measure of the hydrogen ion concentration in solution. The presence of carbonates, hydroxides and bicarbonates increases the basicity (e.g. raises pH) of water while the presence of free mineral acids, carbonic acid and organic acids increase its acidity (e.g. lowers pH). As an index of the hydrogen ion concentration of water, pH is measured on a scale of 0 to 14. A pH value of 7 indicates neutral conditions. Values from 7 to 14 indicate increasing basicity while those 7 to 0 indicate increasing acidity. Most natural surface waters are characterized by pH values in the range of 4 to 9. Ground waters generally tend to be more acidic than surface water.

The pH of surface waters may be influenced by natural conditions (e.g. ice cover, photosynthetic activity) which alter the bicarbonate-carbonate system. Acid mine drainage and industrial wastes that have not been neutralized may significantly lower the pH of water. Alkaline wastewaters, such as those with high ammonia-nitrogen content or caustic soda, may have the opposite effect on a receiving water body.

Waters with pH values outside the range of 6.5 to 8.5 may be undesirable for recreation use (e.g. bathing) as they may be associated with eye and skin irritation. A pH greater than 8.3 may interfere with the disinfection process used for drinking water. Values above 9 may lower the solubility of calcium carbonate causing a preicpitate to form and creating a milky appearance in water. Values less than 5.5 may adversely affect the reproductive potential of fish and other aquatic biota as well as markedly increase the solubility of heavy and trace metals.

A summary of the long-term means and ranges of pH values observed at the various monitoring sites on the river between 1970 and 1982 is presented in Table 3.3.1.

The long-term mean values for pH at the various monitoring sites ranged from 7.9 to 8.4 for both the 1970-1982 period, as a whole, and the 1981-1982 period. A similar range of pH values of individual samples for the river at the Alberta/Saskatchewan border (eg. 7.1-8.9) for the period 1970-1981 was reported by Alberta Environment (1983). There was no indication among these long-term mean values of significant spatial variations in pH from the upper to lower ends of the river in Saskatchewan. At each station the mean pH values were all within and near the upper end of the desirable pH range (6.5-8.5) specified in the existing provincial surface water quality objectives.

Annual mean pH data for each station for the 1970-1982 period are recorded in Appendix 5. These data indicate that annual mean pH values showed little change from year to year during the study period.

Mean values for pH at the various sampling stations calculated on a seasonal basis for the 1970-1982 period are recorded in Table A4.11 (Appendix 4), and have also been plotted in Figure 3.2. Figure 3.2 clearly shows that mean values for pH in each season showed relatively little variation spatially. However, pH values at all stations during the winter season were consistently lower than in the spring/summer and fall seasons examined. The differences in mean seasonal pH values between winter and other seasons tended to be more pronounced in the upper reach of the river (eg. above Prince Albert) and this may be at least partly attributable to increased alkalinity (Table 3.3.2), which imparts resistance to change in pH, observed in at stations in a downstream direction.

Generally lower pH values during the winter season are often observed in productive lakes and even in rivers, like the North Saskatchewan, which have relatively high buffering capacity. Proportionately higher contributions of ground water, presumably at a relatively lower pH than surface waters, may contribute to a lowering of pH in the river under the low flow conditions of winter. Also, under

TABLE 3.3.1
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: pH

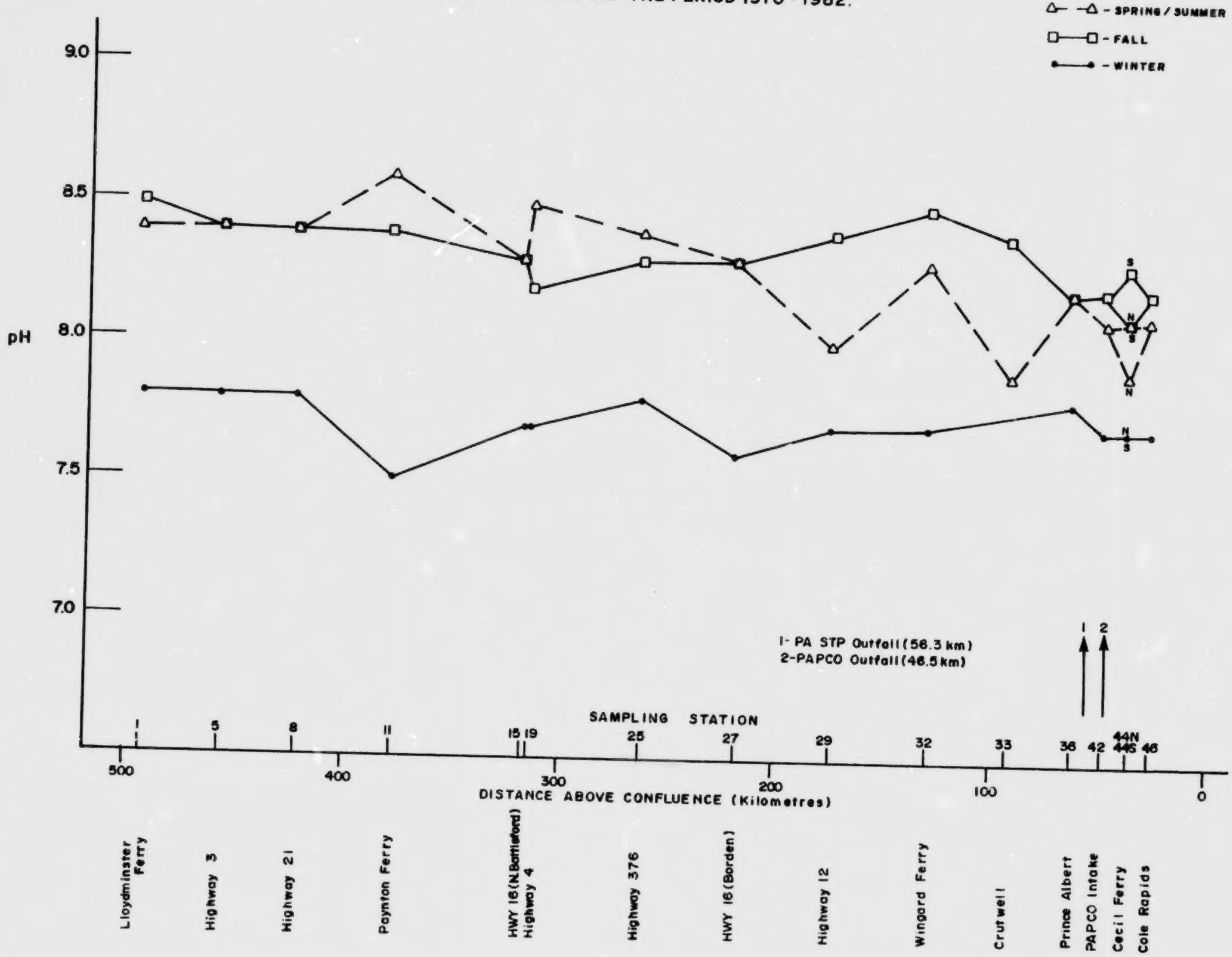
Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	74	8.3	7.3	9.9	42	8.4	7.4	9.0
Highway 3	64	8.2	7.5	9.1	31	8.3	7.5	9.1
Highway 21	48	8.2	7.5	9.0	25	8.3	7.5	9.0
Paynton Ferry	30	8.4	7.3	9.1	30	8.4	7.3	9.1
Highway 16	70	8.2	7.4	8.9	35	8.3	7.4	8.9
Highway 4	35	8.4	7.5	8.9	35	8.4	7.5	8.9
Highway 376	52	8.2	7.6	8.7	32	8.3	7.6	8.7
Borden Bridge	117	8.1	6.9	9.0	60	8.2	7.0	9.0
Highway 12	35	8.1	7.3	8.7	14	8.3	7.5	8.7
Wingard Ferry	16	8.2	7.4	8.6	10	8.4	7.4	8.6
Crutwell Ferry	15	8.1	7.2	8.6	15	8.1	7.2	8.6
P.A. WTP	161	8.1	6.9	9.1	16	8.0	7.1	8.8
PAPCO	156	8.0	5.4	9.2	19	7.9	7.5	8.6
Cecil Ferry N	183	7.9	6.7	8.8	21	7.9	7.2	8.7
Cecil Ferry S	181	8.0	6.2	9.0	21	8.0	7.0	8.8
Cole Rapids	120	8.1	7.1	9.2	27	8.1	7.2	8.6

SSWQ Obj: between 6.5 and 8.5 pH units

n = number of samples MIN = Minimum MAX = Maximum L = less than
SSWQ Obj = Saskatchewan Surface Water Quality Objective

the ice covered conditions of winter there is much less opportunity for exchange of gases between the water and atmosphere. Under such conditions and at low water temperatures greater concentrations of carbon dioxide would be retained in the water and result in greater quantities of carbonic acid which would lower the pH of river water to levels not usually observed in other seasons. This may occur without necessarily significantly altering the alkalinity of the river that is due to bicarbonates.

Figure 3.2, SEASONAL MEAN pH VALUES AT SITES ALONG THE NORTH SASKATCHEWAN RIVER DURING THE PERIOD 1970 - 1982.



Although lower than in other seasons the mean pH values for the winter season were all within the acceptable range specified in the provincial surface water quality objectives.

These data, overall, indicate that significant temporal or spacial variations in pH have not been observed in the North Saskatchewan River. While some of the effluents discharged to the river by municipalities or industry (eg. PAPCO) may have pH values less than that of the river (Saskatchewan Environment 1984) the river is well buffered (Table 3.3.2) and therefore readily dilutes and neutralizes the additional hydrogen ions contributed by effluent discharges.

3.3.2 Alkalinity

Alkalinity is a measure of a water's capacity to neutralize acid. It is expressed as an equivalent of calcium carbonate. Waters with high alkalinity are undesirable because of the associated excessive hardness or high concentrations of sodium salts. Waters with high alkalinity may cause excessive corrosion or encrustation or cause gastrointestinal irritation in young animals or in humans not adapted to such waters. In order to protect aquatic life and for efficient control of water treatment it is desirable that sudden variations in alkalinity from background levels be avoided. Long-term mean and range values for alkalinity at sites along the river are presented in Table 3.3.2. Annual mean data and seasonal mean data for this variable are summarized in Tables 3.3.3 and A4.12, respectively.

Long-term mean values (Table 3.3.2) for alkalinity ranged from 138 mg/L at the Alberta/Saskatchewan border to about 160 mg/L at Prince Albert and other downstream sites. Long-term mean, annual mean and seasonal mean values for alkalinity all indicated a trend towards increased alkalinity in the river in a downstream direction. Generally higher mean alkalinity levels were observed during the winter season, presumably the result of proportionately greater contributions of ground water to the river under winter low flow conditions.

Annual mean values for this variable (Table 3.3.3) suggest that there had been a slight decrease in alkalinity over time since 1970. This trend is not apparent among annual mean data concerning stations in the lower river reach however. Similar trends towards increased alkalinity in a downstream direction and a trend to lower levels over time are also suggested by data compiled by Alberta Environment (1983).

TABLE 3.3.2
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Alkalinity (mg/L)

Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	73	138	104	170	42	135	104	168
Highway 3	64	136	100	206	31	130	100	162
Highway 21	47	140	106	200	25	135	106	160
Paynton Ferry	30	134	90	162	30	134	90	162
Highway 16	70	154	116	449	35	141	122	166
Highway 4	35	136	54	158	35	136	54	158
Highway 376	52	147	118	206	32	144	126	170
Borden Bridge	116	148	100	214	60	145	100	187
Highway 12	35	149	116	212	14	136	116	151
Wingard Ferry	16	151	122	208	10	139	122	150
Crutwell Ferry	15	132	102	150	15	132	102	150
P.A. WTP	158	157	108	299	16	161	134	232
PAPCO	157	162	25	289	19	148	98	202
Cecil Ferry N	181	163	76	400	21	156	108	202
Cecil Ferry S	180	156	10	378	21	152	104	194
Cole Rapids	120	153	105	214	27	150	105	196

SSWQ Obj: Not established;
SDWQ Obj: 500 mg/L as $CaCO_3$

n = number of samples MIN = Minimum MAX = Maximum L = less than
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective

These data indicate that the river is relatively well buffered and capable of resisting changes in pH attributable to inputs of acidic materials. Surface water quality objectives have not been established for alkalinity but a drinking water quality objective of 500 mg/L (as $CaCo_3$) has been designated for Saskatchewan. Alkalinity levels of the river have generally been well below this maximum acceptable concentration pertaining to consumptive use of the river water. The data did not indicate

Table 3.3.3

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Total Alkalinity (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster	-	169	162	147	136	137	134	133	122	156	140	124	141
Highway 3	-	184	-	150	138	135	138	126	124	160	140	123	137
Highway 21	-	183	-	151	155	125	133	132	126	-	143	131	137
Paynton Ferry	-	-	-	-	-	-	-	-	-	-	-	132	135
Highway 16	-	208	251	140	201	151	141	145	137	136	144	141	140
Highway 4	-	-	-	-	-	-	-	-	-	-	-	137	135
Highway 376	-	189	-	154	160	133	150	141	134	-	150	140	146
Borden Bridge	148	187	155	156	163	149	140	139	143	145	157	141	147
Highway 12	-	198	178	123	170	139	154	154	135	-	144	140	136
Wingard Ferry	-	198	169	-	-	-	156	-	136	-	-	-	139
Crutwell Ferry	-	-	-	-	-	-	-	-	-	-	-	-	132
P.A. WTP	-	156	172	160	157	160	149	144	147	157	156	156	169
PAPCO	211	162	172	173	176	166	148	141	143	163	160	161	143
Cecil Ferry N	165	165	169	163	184	165	170	144	145	166	156	159	153
Cecil Ferry S	156	172	168	156	163	147	151	139	135	158	150	152	152
Cole Rapids	-	147	151	167	167	164	148	140	142	162	141	154	148

SSWQ Obj: not established
SDWQ Obj: 500 mg/L as $CaCO_3$

significant increases in alkalinity at any site that could be attributed to effluent discharges.

3.3.3 Conductivity

Conductivity or specific conductance provides a rapid estimate of the total dissolved solids concentration of water. It measures the capacity of water to conduct electric current and is therefore a means of measuring the concentration of major ions which represent most of the dissolved solids present in the water.

A summary of long-term mean values for conductivity at the river monitoring sites are presented in Table 3.3.4. Annual mean values and seasonal mean values for conductivity are presented in Tables 3.3.5 and A4.13, respectively.

The long-term mean data (Table 3.3.4) suggest a trend towards higher conductivity levels in a downstream direction. Annual mean data (Table 3.3.5) as well suggest this trend towards higher conductivity levels in a downstream direction. However annual mean data also indicate a trend towards generally lower values for conductivity at most stations in recent years compared to those recorded in the early 1970's. Such trends were not reported for the river reach in Alberta during the 1970-1981 period (Alberta Environment 1983), however. The long-term mean value (374 mg/L) for conductivity at the Alberta/Saskatchewan border reported by Alberta Environment (1983) was within the range of annual mean levels recorded for this site by Saskatchewan Environment (Table 3.3.5). The reason for the apparent increase in conductivity in a downstream direction in the Saskatchewan River reach may relate to the differences between geological formations in the two provinces through which the river flows.

3.3.4 Total Dissolved Solids

With regard to another variable closely related to conductivity, total dissolved solids (TDS), a similar trend towards increased concentrations in a downstream direction was indicated among long-term mean data for the 1970-1982 period as a whole (Table 3.3.6). This trend was not apparent, however, among mean data for the 1981-1982 period. Temporal data concerning TDS is lacking but that which is available (Table 3.3.7) suggest that levels of TDS, as was noted for conductivity, have slightly decreased generally between 1970 and 1982.

The long-term mean levels of TDS in the North Saskatchewan River ranged from 267-348 mg/L with individual samples having TDS levels up to 565 mg/L in the lower river reach during the winter (Table A4.14).

TABLE 3.3.4
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Conductivity (uS/cm)

Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	74	322	190	475	42	318	229	450
Highway 3	65	325	200	500	31	316	225	500
Highway 21	48	337	210	500	25	335	260	500
Paynton Ferry	30	322	260	410	30	322	260	410
Highway 16	70	375	190	1,100	35	371	280	720
Highway 4	35	347	280	418	35	347	280	418
Highway 376	51	355	250	500	31	354	300	500
Borden Bridge	115	380	250	1,190	59	377	280	1,190
Highway 12	34	369	250	600	14	336	260	400
Wingard Ferry	16	390	320	550	10	349	320	359
Crutwell Ferry	15	344	287	370	15	344	287	370
P.A. WTP	160	396	240	2,000	16	412	278	700
PAPCO	157	405	190	1,400	19	378	284	490
Cecil Ferry N	183	437	220	750	21	432	278	600
Cecil Ferry S	181	392	200	700	20	397	266	700
Cole Rapids	120	383	200	600	27	379	266	532

SSWQ Obj: Not established;

n = number of samples MIN = Minimum MAX = Maximum L = less than
SSWQ Obj = Saskatchewan Surface Water Quality Objective

The mean values of both conductivity and TDS were generally greatest during the winter season at all monitoring sites (Tables A4.13, A4.14) because of ice formation and proportionately greater contributions of ground water during the low flow periods of winter.

Although a water quality objective for TDS in surface waters has not been established, that pertaining to drinking waters in Saskatchewan prescribes a maximum

Table 3.3.5

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Conductivity (us/cm)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster	-	475	348	370	299	350	350	275	300	320	288	293	333
Highway 3	-	500	-	363	322	313	338	290	300	340	325	298	333
Highway 21	-	500	-	350	308	350	325	275	300	-	338	337	333
Paynton Ferry	-	-	-	-	-	-	-	-	-	-	-	301	336
Highway 16	-	404	600	400	360	390	338	275	300	400	338	394	349
Highway 4	-	-	-	-	-	-	-	-	-	-	-	332	355
Highway 376	-	500	-	375	350	375	350	300	300	-	335	339	367
Borden Bridge	393	500	383	419	343	350	350	317	344	413	376	351	395
Highway 12	-	550	450	325	367	350	400	300	300	-	350	370	330
Wingard Ferry	-	198	169	-	-	-	156	-	136	-	-	-	349
Crutwell Ferry	-	-	-	-	-	-	-	-	-	-	-	-	344
P.A. WTP	-	377	380	498	386	398	373	362	368	440	371	387	453
PAPCO	600	435	400	461	410	398	400	328	340	460	363	386	374
Cecil Ferry N	525	468	436	443	430	425	427	398	388	522	392	427	435
Cecil Ferry S	438	419	396	386	387	398	385	361	355	436	357	404	393
Cole Rapids	-	381	361	400	409	410	378	343	337	464	332	375	381

SSWQ Obj: not established

TABLE 3.3.6
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total dissolved solids (mg/L)

Period:		1970 - 1982				1981-1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	40	277	224	399	33	269	224	333
Highway 3	29	267	233	313	23	262	233	313
Highway 21	17	276	231	380	15	268	231	320
Paynton Ferry	25	273	229	401	25	273	229	401
Highway 16	28	289	230	412	25	282	230	348
Highway 4	35	284	235	348	35	284	235	348
Highway 376	27	297	238	365	25	294	238	360
Borden Bridge	41	297	244	422	37	289	244	348
Highway 12	10	279	238	401	8	259	238	300
Wingard Ferry	7	288	250	396	6	267	250	290
Crutwell Ferry	11	274	228	300	11	274	228	300
P.A. WTP	2	348	348	348	0	-	-	-
PAPCO	10	321	222	521	8	273	222	316
Cecil Ferry N	7	344	235	565	4	273	235	314
Cecil Ferry S	7	337	229	506	4	267	229	287
Cole Rapids	11	325	234	501	7	276	234	301

SSWQ Obj: Not established;
SDWQ Obj: 1500 mg/L

n = number of samples MIN = Minimum MAX = Maximum L = less than
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective

desirable concentration for TDS of 1,500 mg/L. As indicated in the data summaries (Tables 3.3.6, A4.14) TDS levels in the North Saskatchewan River were well below this objective value indicating that the water, in terms of this variable, is satisfactory for municipal and private water supply (Saskatchewan Environment 1975).

Table 3.3.7

NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY
ANNUAL MEAN VALUES FOR THE PERIOD 1970 - 1982

Variable: Total Dissolved Solids (mg/L)

Sampling Station	YEAR												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lloydminster	-	-	399	361	285	-	-	-	-	-	-	250	279
Highway 3	-	-	-	-	284	-	-	-	-	-	-	251	272
Highway 21	-	-	-	380	287	-	-	-	-	-	-	260	273
Paynton Ferry	-	-	-	-	-	-	-	-	-	-	-	275	272
Highway 16	-	-	412	358	297	-	-	-	-	-	-	288	276
Highway 4	-	-	-	-	-	-	-	-	-	-	-	287	282
Highway 376	-	-	-	365	313	-	-	-	-	-	-	287	299
Borden Bridge	422	-	394	375	-	-	-	-	-	277	-	278	294
Highway 12	-	-	401	317	-	-	-	-	-	-	-	-	259
Wingard Ferry	-	-	396	-	-	-	-	-	-	-	-	-	270
Crutwell Ferry	-	-	-	-	-	-	-	-	-	-	-	-	273
P.A. WTP	-	-	-	-	-	-	-	-	348	348	-	-	-
PAPCO	-	513	-	-	-	-	-	-	-	-	-	-	273
Cecil Ferry N	486	565	-	-	-	-	270	-	-	-	-	-	273
Cecil Ferry S	430	506	-	-	-	-	355	-	-	-	-	-	267
Cole Rapids	-	499	-	-	-	-	-	-	-	325	-	-	276

SSWQ Obj: not established
SDWQ Obj: 1,500 mg/L

3.3.5 Total Hardness

The total hardness of water is primarily determined by the sum of calcium and magnesium concentrations in water, although other constituents such as iron, and manganese may also contribute to water hardness. Water hardness relates to a water's capability to produce lather from soap. The greater the hardness the more difficult it is to lather soap. Hardness is usually expressed as an equivalent of calcium carbonate ($CaCO_3$) and is measured in mg/L.

Water hardness may influence water use in a number of ways. Waters with hardness less than 120 mg/L are generally deemed suitable for most uses, while at hardness levels in excess of 500 mg/L water may be considered unsuitable for most industrial and domestic uses unless treated ("softened") by some means.

Mean values for hardness of water at various sites along the North Saskatchewan River are presented in Table 3.3.8. Very little data concerning water hardness is available for the river for years prior to 1981, so long trends and seasonal variations in hardness cannot be reliably described. However, the available data, which was mostly gathered in the 1981-1982 study period, show the river water long-term mean hardness values to range from 154 to 214 mg/L at the various sites examined. The hardness values were relatively uniform from the Alberta/Saskatchewan border to the lower river reach, although somewhat higher mean levels were recorded for the Prince Albert water treatment plant (214 mg/L based on 2 samples) and at the Cecil Ferry north station (199 mg/L) areas. Hardness data published by Alberta Environment (1983) showed that hardness levels in the Alberta reach of the river were similar to those in upper reach of the river in Saskatchewan.

Seasonal mean levels of hardness are recorded in Table A4.15 and are based on a limited amount of data for some stations. The winter mean hardness values were higher for all stations (range 178-266 mg/L) than for the spring/summer and fall seasons. Higher hardness levels are typical of surface waters under ice cover conditions and on the North Saskatchewan River because of proportionately greater ground water contributions to the river under winter low flows.

These data indicate that the North Saskatchewan River may be classified as a hard water surface water body (Environment Canada 1979) although the levels of hardness at all sites were far below the provincial drinking water quality objective (800 mg/L) and therefore satisfactory for most industrial and domestic uses.

TABLE 3.3.8
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Hardness (mg/L)

Period:		1970 - 1982				1981-1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	42	171	140	220	35	170	140	208
Highway 3	30	166	136	200	24	165	136	200
Highway 21	20	169	136	212	18	167	136	208
Paynton Ferry	26	174	148	208	26	174	148	208
Highway 16	30	175	144	224	27	172	144	212
Highway 4	35	173	148	216	35	173	148	216
Highway 376	27	177	152	220	25	175	152	220
Borden Bridge	44	178	148	234	39	176	148	224
Highway 12	10	161	140	216	8	154	140	176
Wingard Ferry	7	170	148	224	6	161	148	176
Crutwell Ferry	11	154	124	176	11	154	124	176
P.A. WTP	2	214	208	220	0	-	-	-
PAPCO	10	173	124	272	8	150	124	172
Cecil Ferry N	7	199	136	276	4	182	136	264
Cecil Ferry S	8	178	108	268	4	154	124	168
Cole Rapids	15	183	136	256	9	160	136	180

SSWQ Obj: Not established;
SDWQ Obj: 800 mg/L (as $CaCO_3$)

n = number of samples MIN = Minimum MAX = Maximum L = less than
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective

3.3.6 Major Ions

Ions and dissolved salts of calcium and magnesium are the two main components contributing to water hardness. These constituents plus sodium, sulphates, chlorides and potassium also contribute most significantly to the total dissolved solids concentration in water. The levels of these individual constituents may influence the suitability of surface water for irrigation of agricultural and horticultural crops. Also, they may affect the suitability of water used for domestic, consumptive and industrial purposes.

The long-term mean levels of chloride and potassium, sodium and magnesium, and sulphate and calcium have been presented in Tables 3.3.9, 3.3.10, and 3.3.11, respectively. These data indicate that mean values over the 1970-1982 period displayed a trend to increased levels of chloride, potassium, sodium, and sulphate in a downstream direction from the Alberta/Saskatchewan border. Also, mean values for chloride, sodium and sulphate for the 1981-1982 period show a trend to decreased levels of these variables compared to those for the 1970-1982 period as a whole.

Long-term mean levels of magnesium (Table 3.3.10) and calcium (Table 3.3.11) were relatively uniform from the upper to lower reaches of the river in Saskatchewan.

Seasonal mean levels of chloride, sodium, magnesium, sulphate and calcium were generally higher at all monitoring sites during the winter (Table A4.16, A4.18 to A4.20, respectively) under the influence of ice cover and proportionately greater inputs of ground water under winter low flow conditions. Conversely, spring/summer mean levels of potassium tended to be slightly higher than in fall or winter at most sites (Table A4.17). With the exception of potassium, the levels of major ions in the river at most locations displayed the same seasonal and spatial trends as observed for TDS during the 1970-1982 period (Section 3.3.4).

The surface and drinking water quality objectives pertaining to major ions have been established to protect the most sensitive uses made of water. Specific drinking water quality objectives for Saskatchewan have been established for chloride (250 mg/L), sodium (300 mg/L), magnesium (200 mg/L), and sulphate (500 mg/L) by Saskatchewan Environment (1980). The levels of these constituents in the North Saskatchewan River have generally been well below these objective values although under winter conditions individual sample results at a few stations have exceeded the levels occasionally.

A surface water quality objective has been established for sodium as it relates to the irrigational use of water (Saskatchewan Environment 1975). Sodium may influence the suitability of surface water for agricultural irrigation as it may adversely influence soil structure and permeability by displacing calcium and magnesium and result in alkali soils unsuitable for production of sensitive crops. Under the existing surface water quality objectives for Saskatchewan sodium concentrations in water should not exceed the range of 30 to 75 per cent of the cations present (e.g. mainly sodium, calcium, magnesium, potassium).

TABLE 3.3.9
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Chloride (mg/L)

Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	74	8.2	0.9	23	42	6.1	1.9	20
Highway 3	65	8.2	1.9	33	31	5.1	1.9	12
Highway 21	48	8.1	1.9	38	25	4.9	1.9	12
Paynton Ferry	30	4.5	1.9	22	30	4.5	1.9	22
Highway 16	70	10.5	1.9	148	35	4.7	1.9	16
Highway 4	35	3.9	1.9	12	35	3.9	1.9	12
Highway 376	52	7.9	1.9	34	32	5.5	1.9	18
Borden Bridge	117	11.3	1.9	266	60	13	2.0	266
Highway 12	35	11.5	1.9	40	14	5.3	1.9	18
Wingard Ferry	16	13.9	2.0	46	10	5.6	2.0	18
Crutwell Ferry	15	5.6	2.0	18	15	5.6	2.0	18
P.A. WTP	158	12.4	0.9	312	16	11	1.9	36
PAPCO	157	12.8	1.9	150	19	6.3	2.0	12
Cecil Ferry N	181	25.1	1.9	80	21	20	2.0	42
Cecil Ferry S	181	11.7	1.9	84	21	7.6	1.9	22
Cole Rapids	120	11.2	1.9	49	27	10	2.0	34

SSWQ Obj: not established
SDWQ Obj: 250 mg/L

Variable: Potassium (mg/L)

Period:	1970 - 1982				1981 - 1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	35	1.5	1.0	3.0	35	1.5	1.0	3.0
Highway 3	24	1.5	1.0	2.0	24	1.5	1.0	2.0
Highway 21	18	1.8	1.0	2.0	18	1.8	1.0	2.0
Paynton Ferry	28	1.7	1.0	2.0	28	1.7	1.0	2.0
Highway 16	27	2.0	1.0	3.0	27	2.0	1.0	3.0
Highway 4	35	1.9	1.0	3.0	35	1.9	1.0	3.0
Highway 376	24	2.3	2.0	3.0	24	2.3	2.0	3.0
Borden Bridge	38	2.0	1.0	3.0	37	2.0	1.0	3.0
Highway 12	8	2.8	2.0	4.0	8	2.7	2.0	4.0
Wingard Ferry	6	2.3	2.0	4.0	6	2.3	2.0	4.0
Crutwell Ferry	11	3.4	2.0	5.0	11	3.5	2.0	5.0
P.A. WTP	2	1.0	1.0	1.0	0	-	-	-
PAPCO	8	4.9	2.0	7.0	8	4.9	2.0	7.0
Cecil Ferry N	5	3.6	2.0	5.0	4	3.8	2.0	5.0
Cecil Ferry S	6	5.5	2.0	16.0	4	3.8	2.0	5.0
Cole Rapids	11	3.4	2.0	6.0	8	3.9	2.0	6.0

SSWQ Obj: not established
SDWQ Obj: not established
n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective

TABLE 3.3.10
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Sodium (mg/L)

Period:		1970 - 1982				1981-1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	53	11	4	26	35	8.0	4	13
Highway 3	39	10	4	33	24	7.4	4	12
Highway 21	29	11	3	33	18	6.7	3	11
Paynton Ferry	28	7	3	10	28	7.0	3	10
Highway 16	40	17	4	198	27	7.6	4	11
Highway 4	35	9	4	59	35	9.5	4	59
Highway 376	34	13	5	34	25	9.6	5	18
Borden Bridge	53	15	.02	41	37	11	.02	38
Highway 12	20	19	8	40	8	10	8	13
Wingard Ferry	10	18	9	39	6	16	9	14
Crutwell Ferry	11	12	11	14	11	12	11	14
P.A. WTP	103	24	7	324	0	-	-	-
PAPCO	149	20	6	73	18	12	9	16
Cecil Ferry N	169	29	7	60	19	22	8	35
Cecil Ferry S	120	22	6	44	5	11	9	13
Cole Rapids	112	19	6	54	21	15	7	26

SSWQ Obj: see Saskatchewan Environment (1975)
SDWQ Obj: 300 mg/L

Variable: Magnesium (mg/L)

Period:		1970 - 1982				1981 - 1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	38	15	7	20	32	15	7	20
Highway 3	29	15	10	21	23	15	10	21
Highway 21	19	15	7	21	17	14	7	18
Paynton Ferry	25	16	11	24	25	16	11	24
Highway 16	27	15	10	21	25	15	10	21
Highway 4	31	15	11	20	31	15	11	20
Highway 376	26	15	9	21	24	15	9	21
Borden Bridge	36	17	5	29	33	17	5	29
Highway 12	9	16	12	19	8	15	12	19
Wingard Ferry	6	14	8	17	6	14	8	17
Crutwell Ferry	11	14	10	17	11	14	10	17
P.A. WTP	2	22	22	22	0	-	-	-
PAPCO	8	13	9	17	8	13	9	17
Cecil Ferry N	5	13	8	17	4	13	8	17
Cecil Ferry S	5	15	9	21	4	13	9	16
Cole Rapids	10	16	13	19	8	16	13	19

SSWQ Obj: not established
SDWQ Obj: 200 mg/L
n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective
- = not determined

TABLE 3.3.11
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Sulphate (mg/L)

Period:		1970 - 1982				1981-1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	53	43	20	68	35	40	20	60
Highway 3	40	44	20	82	25	41	20	59
Highway 21	28	45	28	82	17	40	28	60
Paynton Ferry	26	43	24	62	26	43	24	62
Highway 16	41	57	20	340	28	44	20	68
Highway 4	35	47	28	71	35	47	28	71
Highway 376	34	50	28	78	25	48	28	65
Borden Bridge	56	51	33	112	38	44	33	63
Highway 12	20	59	32	94	8	38	32	44
Wingard Ferry	10	54	36	90	6	39	36	40
Crutwell Ferry	11	49	40	64	11	49	40	64
P.A. WTP	103	61	23	230	0	-	-	-
PAPCO	148	66	20	970	18	53	36	72
Cecil Ferry N	169	62	15	142	19	52	38	80
Cecil Ferry S	118	59	9	180	5	42	38	48
Cole Rapids	111	54	20	104	19	48	20	67

SSWQ Obj: not established
SDWQ Obj: 500 mg/L

Variable: Calcium (mg/L)

Period:		1970 - 1982				1981 - 1982		
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	39	44	32	64	33	43	32	53
Highway 3	29	42	32	50	23	42	32	50
Highway 21	19	43	34	54	17	43	34	54
Paynton Ferry	25	46	29	132	25	46	29	132
Highway 16	27	44	38	56	25	44	28	53
Highway 4	32	44	14	58	32	44	14	58
Highway 376	27	45	13	56	25	45	13	56
Borden Bridge	37	42	24	54	34	42	24	51
Highway 12	9	37	34	42	8	37	34	42
Wingard Ferry	6	40	37	43	6	40	37	43
Crutwell Ferry	11	39	34	43	11	39	34	43
P.A. WTP	2	48	46	51	0	-	-	-
PAPCO	8	39	34	48	8	39	34	48
Cecil Ferry N	5	40	37	45	4	40	37	45
Cecil Ferry S	5	42	35	48	4	40	35	43
Cole Rapids	10	38	32	45	8	37	32	45

SSWQ Obj: relates to other ions (See Saskatchewan Environment 1975)
SDWQ Obj: relates to other ions (See Saskatchewan Environment 1975)
n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective
SDWQ Obj = Saskatchewan Drinking Water Quality Objective
- = not determined

Table 3.3.12 summarizes the long-term mean concentrations of cations and presents calculated percentages of sodium for the various monitoring sites along the North Saskatchewan River.

As was discussed above with regard to the trend to increased levels of major ions in a downstream direction on the river reach in Saskatchewan the percentage of cations comprised of sodium showed a similar increase in the downstream direction. At all sites except the Cecil Ferry north station all values for per cent sodium were less then 30%. At all sites, however, water quality was satisfactory with regard to the sodium variable addressed in the current surface water quality objectives.

Another guideline for assessing the suitability of surface waters for irrigation involves the calculation of sodium adsorption ratio (SAR). SAR values are calculated using milliequivalents of sodium, calcium and magnesium in the following formula (Environment Canada 1979):

$$\mathrm{SAR} = \frac{\text{Sodium}}{\sqrt{\dfrac{\text{Calcium + Magnesium}}{2}}}$$

SAR values for each monitoring site examined were calculated on this basis. These calculated SAR values

TABLE 3.3.12
MEAN CONCENTRATIONS OF MAJOR CATIONS AND PERCENTAGE OF CATIONS AS SODIUM AT VARIOUS SITES ON THE NORTH SASKATCHEWAN RIVER DURING THE PERIOD 1970 - 1982

Sampling Station	Mean concentration of cations (mg/L)					
	Sodium	Calcium	Magnesium	Potassium	Sum of Cations	Percent Sodium
Lloydminster	11	44	15	1.5	71.5	15.4
Highway 3	10	42	15	1.5	68.5	14.6
Highway 21	11	43	15	1.8	70.8	15.5
Paynton Ferry	7	46	16	1.7	70.7	9.9
Highway 16	17	44	15	2.0	78.0	21.8
Highway 4	9	44	15	1.9	70.3	12.8
Highway 376	13	45	15	2.3	75.3	17.3
Borden Bridge	15	42	17	2.0	76.0	19.7
Highway 12	19	37	16	2.8	74.8	25.4
Wingard Ferry	18	40	14	2.3	74.3	24.2
Crutwell Ferry	12	39	14	3.4	68.4	17.5
P.A. WTP	24	48	22	1.0	95.0	25.3
PAPCO	20	39	13	4.9	76.9	26.0
Cecil Ferry N	29	40	13	3.6	85.6	33.9
Cecil Ferry S	22	42	15	5.5	84.5	26.0
Cole Rapids	19	38	16	3.4	76.4	24.9

SSWQ Obj: less than 30 to 75% of cations.

TABLE 3.3.13
SODIUM ADSORPTION RATIOS FOR VARIOUS SITES ALONG THE NORTH SASKATCHEWAN RIVER *

Sampling Station	Meq. Sodium	Meq. Calcium	Meq. Magnesium	Sodium Adsorption Ratio (meq/L)
Lloydminster	.478	2.2	1.24	.365
Highway 3	.435	2.1	1.24	.337
Highway 21	.478	2.15	1.24	.368
Paynton Ferry	.304	2.3	1.32	.225
Highway 16	.739	2.2	1.24	.564
Highway 4	.391	2.2	1.24	.298
Highway 376	.565	2.25	1.24	.428
Borden Bridge	.652	2.1	1.40	.494
Highway 12	.826	1.85	1.32	.656
Wingard Ferry	.782	2.0	1.16	.621
Crutwell Ferry	.521	1.95	1.16	.417
P.A. WTP	1.043	2.4	1.82	.719
PAPCO	.870	1.95	1.07	.707
Cecil Ferry N	1.261	2.0	1.07	1.017
Cecil Ferry S	.957	2.1	1.24	.742
Cole Rapids	.826	1.9	1.32	.650

* calculated using mean values for sodium, calcium, magnesium for the period 1970-1982. meq. = milliequivalents

are presented in Table 3.3.13. SAR values showed a trend to nigher values in a downstream direction as was noted previously for major ion levels in general. SAR values at all sites except Cecil Ferry north were less than 0.8 meq/L. For Cecil Ferry north an SAR of 1.0 meq/L was recorded. At the conductivity levels characteristic of the North Saskatchewan River (generally less than 400 us/cm Table 3.3.4) these results suggest that the river water would be suitable for irrigation of all soil types (Environment Canada 1979), and presumably all crops likely to be grown in this area of Saskatchewan.

3.3.7 Colour

Colour (apparent colour) is a measure of the dissolved and suspended colouring materials present in water. The colour may be attributable to the presence of organic and inorganic substances. Colour data for the stations on the North Saskatchwan River are limited to the period since 1980.

Mean values for each station for the 1981-1982 period are recorded in Table 3.3.14. Seasonal mean data for colour are presented in Table A4.22.

Mean levels of colour in the river ranged from 8.3 to 66 colour units during the 1981-1982 period. The highest individual colour values were generally observed at the Cecil Ferry north location due to the influence of the brown-coloured effluent plume originating at the PAPCO mill discharge. Seasonal mean values were generally higher in the spring/summer season than in other seasons at all stations likely because of increased quantities of suspended sediments in the water during the high flow periods and because of higher levels of algae in the water in summer. The seasonal mean data also show the Cecil Ferry north location to have generally higher colour levels than at most other stations in all seasons examined. A high colour level (134 colour units) was observed at the Highway 12 crossing in summer and this single value biased the mean (74 colour units) for this station.

The colour of the river water is mainly significant from the standpoint of aesthetic acceptance of the water for domestic and recreational purposes. The existing surface water quality objective concerning colour requires that uses of the water body (e.g. for effluent discharge) not increase the colour by more than 30 units above natural levels. The data in Tables A3.22 and A4.22 suggest that such significant increases have occurred in the river at Cecil Ferry north probably as a result of discharges of treated pulp mill effluent upstream of this site. The colour values of the river at the next downstream site

TABLE 3.3.14
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Colour (apparent) colour units

Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	5	11.0	5	20	5	11.0	5	20
Highway 3	5	8.6	4	19	5	8.6	4	19
Highway 21	4	8.2	4	20	4	8.3	4	20
Paynton Ferry	5	8.6	5	13	5	8.6	5	13
Highway 16	5	10	5	14	5	10.0	5	14
Highway 4	6	11	5	17	6	10.8	5	17
Highway 376	5	6.8	0.5	13	5	6.8	.05	13
Borden Bridge	7	9.9	6	15	7	9.9	6	15
Highway 12	2	74	13	134	2	74	13	134
Wingard Ferry	2	43	14	71	2	43	14	71
Crutwell Ferry	1	13	13	13	1	13	13	13
P.A. WTP	2	9.0	5	13	2	9.0	5	13
PAPCO	14	12	6	30	11	9.4	6	17
Cecil Ferry N	20	60	9	320	16	66	15	320
Cecil Ferry S	17	13	0.9	69	14	13	.90	69
Cole Rapids	17	19	9	38	13	19	9	38

SSWQ Obj: not to be increased by more than 30 colour units above natural levels

n = number of samples MIN = Minimum MAX = Maximum
SSWQ Obj = Saskatchewan Surface Water Quality Objective

(Cole Rapids), however, suggests that the influence of the pulp mill effluent on the river is limited to a relatively short reach of river as at Cole Rapids mean colour levels had declined to levels acceptable under the existing surface water quality objective. A similar conclusion was made with regard to the results of another study conducted in this river reach in autumn of 1983 (Saskatchewan Environment 1984).

3.3.8 Total Suspended Solids/Turbidity

Total suspended solids (TSS) levels in rivers are generally flow related with maximum levels occurring during high flow periods. The levels of TSS may vary considerably from one location to another at any given time because of differences in the size and mass of suspended materials (eg. sand, silt, etc.) and differences in river velocity at different locations which keep particles in suspension or permit them to settle out. Inorganic and organic materials (eg. silt, clay, sand, algae, detritus) contribute to the TSS levels in rivers and may be derived from the river and its tributaries in the watershed as well as through man made inputs (effluent discharges, storm waters) and activities (dredging, construction). TSS is measured in mg/L.

Turbidity, which may relate to flows as well, is a measure of the suspended particles such as clay, silt, organic matter, plankton and microbes in water which are held in suspension by turbulent flow and Brownian (molecular) motion. Turbidity is measured by comparing the optical interferences of suspended particles to the transmission of light with standardized suspensions of particles. Turbidity is measured in Nepholometric Tubridity Units (NTU).

TSS and turbidity can influence water quality and water use by giving water a dirty or muddy appearance. By reducing water clarity TSS and turbidity at high levels may reduce light penetration in water and thus reduce photosynthetic activity of plants and algae. Also, TSS and turbidity may directly influence other biological communities in rivers in areas where settling occurs by smothering benthic organisms and spawning beds. TSS may also be a means of transport of large quantities of nutrients (e.g. phosphorus) and heavy metals from one location to another downstream. It may interfere with water supply by fouling intake areas and damage pumps and water distribution systems. High turbidities may also create additional water treatment problems for domestic, municipal and industrial supplies and may reduce disinfection treatment efficiency if adequate water clarification is not achieved. High levels of these variables may also interfere with procedures used for chemical and bacteriological analyses of water.

Data concerning long-term mean values for TSS and turbidity in the North Saskatchewan River are summarized in Table 3.3.15. Annual mean levels of each variable at the different monitoring sites are recorded in Appendix 5. Seasonal mean values for TSS and turbidity are recorded in Tables A4.23 and A4.24, respectively.

Long-term mean levels of TSS at the various monitoring sites ranged from 39 to 206 mg/L although very high levels of TSS (e.g. greater than 1,000 mg/L) in individual samples (maximum values) were recorded for most sites examined during the 1970-1982 period (Table 3.3.15). Mean values for TSS in the 1981-1982 period were similar to those observed over the 1970-1982 as a whole. Mean TSS levels were highly variable throughout the river reach during the 1970-1982 period as a whole with no spatial trend apparent.

Turbidity data is limited to that obtained in the 1981-1982 study period. Mean turbidity levels ranged from 16 to 155 NTU (Table 3.3.15). The means values for all seasons showed a tendency for increased turbidity levels in the lower river reach from Crutwell Ferry to Cole Rapids (Table A4.24). The reason for higher turbidity levels in the lower river reach is unclear but may relate to erosion of the muddy and steep banks in this lower reach. As noted for TSS, nearly all sites examined were characterized by periodically very high turbidity levels in individual samples.

Seasonal data concerning both variables (Tables A4.23, A4.24) clearly indicate the flow-related nature of TSS and turbidity in the North Saskatchewan River. Mean levels of TSS and turbidity were highest during the high flow periods

TABLE 3.3.15
NORTH SASKATCHEWAN RIVER WATER QUALITY DATA SUMMARY

Variable: Total Suspended Solids (mg/L)

Period:	1970 - 1982				1981-1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster	73	79	3	1268	42	94	3	1268
Highway 3	64	85	2	1470	31	126	5	1470
Highway 21	47	101	3	1824	25	136	5	1824
Paynton Ferry	29	55	5	317	29	55	5	317
Highway 16	66	127	4	1498	35	198	4	1498
Highway 4	35	206	7	1622	35	206	7	1622
Highway 376	51	99	3	796	32	137	3	796
Borden Bridge	113	58	4	642	59	62	5	642
Highway 12	34	117	4	1165	14	248	23	1165
Wingard Ferry	15	39	6	140	10	52	21	140
Crutwell Ferry	15	237	22	1154	15	237	22	1154
P.A. WTP	155	76	4	1277	16	62	6	550
PAPCO	156	122	2	1564	19	177	6	776
Cecil Ferry N	181	108	3	1992	21	104	5	758
Cecil Ferry S	179	88	2	1580	21	85	4	670
Cole Rapids	121	107	3	1018	27	162	6	956

SSWQ Obj: not established

Variable: Turbidity (Nephelometric Turbidity Units)

Period:	1970 - 1982*				1981 - 1982			
	n	Mean	MIN.	MAX.	n	Mean	MIN.	MAX.
Lloydminster					8	77	1.0	450
Highway 3					7	85	1.5	450
Highway 21					6	102	1.4	490
Paynton Ferry					8	81	1.6	500
Highway 16					7	89	3.9	230
Highway 4					8	62	4.8	160
Highway 376					7	57	3.0	230
Borden Bridge					8	16	0.7	39
Highway 12					2	135	20	250
Wingard Ferry					2	55	17	93
Crutwell Ferry					7	123	19	220
P.A. WTP					0	-	-	-
PAPCO					9	112	0.0	220
Cecil Ferry N					3	137	100	200
Cecil Ferry S					2	155	100	210
Cole Rapids					6	124	19	220

SSWQ Obj: not to exceed more than 25 turbidity units above natural value

n = number of samples MIN = Minimum MAX = Maximum

SSWQ Obj = Saskatchewan Surface Water Quality Objective

* not determined prior to 1981

of the spring/summer season. Mean TSS and turbidity levels in spring/summer ranged from 81 to 377 mg/L and 17 to 155 NTU, respectively. During the fall and winter seasons, under coincidentally lower river flows (Figure 1.2), mean TSS levels ranged from 5 to 48 mg/L while turbidity levels ranged from only 0.0 to 11 NTU.

These data show the North Saskatchewan River to be subject to high TSS and turbidity levels during the high flow periods of spring and summer. During these periods TSS and turbidity levels may pose an increased burden to water treatment when the water is used for domestic, municipal or industrial supply.

3.4 Heavy and Trace Metals

Heavy metal and trace substances in surface waters are primarily of concern with regard to the consumptive and irrigational uses of water, and to the aquatic biota and wildlife which utilize the water. These variables may occur naturally in a water body mostly in association with bottom sediments and substrates. Generally, only minute quantities of heavy and trace metals are present in the water column since physical, chemical and biological processes tend to remove dissolved metals from the water while others associated with mineral particulates tend to settle out of suspension in slower moving portions of rivers. Generally, only the various forms of dissolved metals and metals associated with organic substances are of direct concern to aquatic biota and water consumers. However, changes in physical/chemical conditions of water such as oxygen depletion (anaerobic conditions) may facilitate the release of additional metals from the river substrate to the water column.

Metals may also be added to a water body through the discharge of industrial and municipal effluents. Since dissolved or biologically available forms of most metals are rarely present in the water column of rivers at significant concentrations, the analyses of water samples has generally been conducted to quantitate the total concentrations (particulate and dissolved) of metals present.

Some trace metals such as mercury may be present at very minute levels in water and yet be accumulated in aquatic biota rendering organisms in some food chains unsuitable for human consumption. Total metal analyses provides an indication of the quantities of such metals that potentially could become available for biological uptake.

Surface and drinking water quality objectives have been established for total concentrations of heavy metals and trace substances (Saskatchewan Environment 1975, 1980). A summary of mean concentrations of these variables observed in the river over the 1970-1982 period is presented in Table 3.4.1. Long-term mean values for each variable at the various monitoring sites have been recorded in Tables A3.25 to A3.43 of Appendix 3.

As shown in Table 3.4.1 mean levels of arsenic, barium, boron, chromium, cyanide, lead, mercury, selenium, silver, and zinc were all below the maximum acceptable levels specified in the existing provincial surface water quality objectives. The mean levels of other metals including cobalt, molybdenum, nickel, uranium and vanadium, were below the respective values of 50, 10, 25, 20 and 100 micrograms per litre suggested for protection of various water uses (irrigation, protection of aquatic life etc.) by Environment Canada (1979).

Cadmium, copper and silver were the only three heavy metal variables for which mean values exceeded the respective surface water quality objectives. The exceedance of objective levels for cadmium and silver, however were influenced by single samples containing the elevated levels of total cadmium and silver and this may have had a disproportionate bias upon the calculated mean values for the stations where the high levels were recorded (see Tables A3.29 and A.40). The results for copper, however, are based upon a greater number of analyses (Table A3.32) and may indicate a need for further investigation at Station 19 (Highway 4 crossing) to confirm or determine the reasons for the relatively higher total copper level at this location near North Battleford. As indicated earlier, however, most of the total metal concentrations detected in the river are probably related to the presence of suspended material containing the metal(s) and thus would likely be mostly removed from water by conventional filtration, sedimentation and clarification procedures used in municipal water supply systems.

Long-term mean data for the heavy metal and trace constituents (Tables A3.25 to A3.43) also reveal that the ranges of these constituents at the monitoring stations were highly variable and did not display any apparent trend towards increased levels in a downstream direction. There was a tendency among the long-term mean levels for barium to be higher in the lower river reach and this may be related to ground water influence but additional data would need to be obtained to determine if such spatial or temproal trends were occurring for this and other related variables.

As noted in Section 3.3.8 the movement of suspended solids in rivers may be a means of transporting large quantities of heavy and trace metals, as well as other substances, to lower reaches and to downstream lakes and reservoirs where the suspended materials tend to settle out and accumulate. The suspended solids samples collected during the high flow event of July, 1981 (Section 2.4) were analyzed for heavy and trace metal contents to provide baseline information about the concentration of these variables in suspended solids of the North Saskatchewan River. The results of these analyses are recorded in Appendix 6.

The results of particle size and heavy and trace metal analyses of suspended solids samples indicate that under the high flow conditions of July, 1981, the relative proportion of various sizes of particles as well as the concentrations of metals were relatively uniform along the entire river reach. The results shown in Appendix 6 represent single-sample results and cannot be interpreted in terms of existing water quality objectives or potential impacts on water use. Instead, the results provide preliminary baseline information about the transport of metals in the North Saskatchewan River. Similar studies currently being conducted by the Inland Waters Directorate of Environment Canada may provide valuable additional information about the transport of metals and other substances in this and other rivers.

TABLE 3.4.1

RANGE OF MEAN CONCENTRATIONS OF HEAVY METAL AND TRACE SUBSTANCES OBSERVED AT SAMPLING SITES ON THE NORTH SASKATCHEWAN RIVER FROM 1970-1982

Variable	Number of Samples	Range of mean Concentrations	SSWQ Obj.
Aluminum	107	.011 - 6.67	--
Arsenic	100	.600 - 2.80*	10 ug/L*
Barium	80	.059 - .167	1.0
Boron	55	.010 - .063	0.5
Cadmium	114	.001 - .045	0.01
Chromium	115	.002 - .014	0.05
Cobalt	101	.001 - .011	--
Copper	121	.008 - .036	0.02
Cyanide	103	.09 - 8.0*	10 ug/L*
Lead	115	.004 - .010	0.05
Mercury	137	.019 - .077*	0.1 ug/L*
Molybdenum	84	.004 - .008	--
Nickel	111	.003 - .022	--
Selenium	55	.001 - .005	0.01
Silver	51	.001 - .090	0.05
Uranium	16	.010 - 2.30*	--
Vanadium	84	.010 - .017	--
Zinc	115	.018 - .140	0.05

SSWQ Obj = Saskatchewan Surface Water Quality Objective (Saskatchewan Environment 1975)

* Values in micrograms per litre; all other data in milligrams per litre.

-- = SSWQ Obj. not established

3.5 Pesticides

Pesticides are chemical compounds (organic or inorganic) used to control organisms (insects, microbes, etc.) which attack crops, animals and man. Pesticides include chemicals known as insecticides, herbicides and fungicides. In Saskatchewan the major use of pesticides is for the control of insects, fungi and weeds which interfere with cereal or other agricultural crop production and crop yields. Other such chemicals are also used for the control of rodents and aquatic weeds and algae, though on a much smaller scale.

Pesticides have both beneficial and detrimental characteristics and may be regarded as environmental contaminants if they extend beyond the area of intentional application or persist longer than is necessary to control the pest. A major concern over the use of chemical pesticides is their accumulation in organisms of food webs.

Pesticides may reach the aquatic environment in a number of ways (Environment Canada, 1979): by drift of aerial spraying, surface runoff, percolation to ground waters which infiltrate lakes or rivers, by direct application to water to control aquatic organisms, by accidental spillage and by sewage and industrial effluent discharges. Pesticides may also enter water through atmospheric transport of wind borne soil and particulates to which the pesticides may be absorbed. Additional general information about pesticides in aquatic environments has been published by Environment Canada (1979). Pesticides in water are of concern with regard to fish and other aquatic organisms and to their influence on other water uses including drinking water supply and irrigation.

In the monitoring of the North Saskatchewan River water samples were obtained periodically from various sampling sites and analyzed for up to 30 different pesticides. A list of pesticides usually determined in such samples is presented in Table 3.5.1. The detection limits for these substances in water range from 0.001 to 0.01 ug/L for those in the organochlorine/polychlorinated biphenyl group and from 0.002 to 0.2 ug/L for the phenoxyacid and trichloropicolinic herbicides.

Detailed data concerning these chemicals in water of the North Saskatchewan River are stored on the ESQUADAT and NAQUADAT computer systems and are available upon request. Most pesticide data were obtained during the 1981-82 survey period. Also, monitoring stations from the Highway 12 crossing to Cecil Ferry inclusively were not examined for these variables.

During the 1981-1982 study period the concentrations of all but five of the pesticides (Table 3.5.1) for which analyses were performed were below the existing detection limits of the analytical procedures used. For two of these variables 2,4-DP at

Table 3.5.1

LIST OF PESTICIDES VARIABLES DETERMINED IN SAMPLES FROM THE NORTH SASKATCHEWAN RIVER

PHENOXYACID HERBICIDES

2,4-D
2,4,5-T
2,4-DB
2,4-DP
MCPA
Silvex

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS

Hexachlorobenzene
Alpha-BHC
Lindane
Heptachlor
Aldrin
Heptachlor Epoxide
(Gamma) Chlordane
Alpha-Chlordane
Endrin
Dieldrin
Alpha-Endosulfan
Beta-Endosulfan
p,p'-DDT
p,p'-DDE
p,p'-DDD
o,p'-DDT
Mirex
p,p'-Methoxychlor
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Total PCB

TRICHLOROPICOLINIC HERBICIDES

Picloram

Highway 21 (Station 8) and 2,4,5-T at Cole Rapids (Station 46) trace levels, 0.004 and 0.03 ug/L respectively, were detected on one occasion only. Such minute levels of these herbicides in surface water are not considered significant with regard to current water uses along and within the North Saskatchewan River.

The other three pesticides (2,4-D, alpha BHC, and gamma BHC) are frequently observed in surface waters of agricultural areas at trace levels. A summary of the levels of these compounds observed in the North Saskatchewan River is presented in Table A3.42-A3.44 of Appendix 3.

These data show that during the 1981-1982 period mean levels of the herbicide 2,4-D ranged from 0.004 to 0.108 ug/L at the nine sites examined (Table A4.43). The highest mean level was recorded for the station at the Alberta/Saskatchewan border (Lloydminster Ferry) although a similar mean level (0.103 ug/L) was recorded for the Cole Rapids site. Maximum values of 2,4-D in individual samples ranged from 0.004 to 0.3 ug/L. At such low levels 2,4-D would not be considered harmful to aquatic organisms and fishes (Environment Canada, 1979) or impair any other known water uses along the North Saskatchewan River. These levels of 2,4-D are well below the maximum acceptable concentration (100 ug/L) specified in the Saskatchewan drinking water quality objectives (Saskatchewan Environment, 1980).

Slightly higher mean levels of 2,4-D (0.7 ug/L) were reported by Alberta Environment (1983) for the river at the Alberta/Saskatchewan border during the period 1978 to 1981. Again this reported level of 2, 4-D is not considered significant in terms of water quality or existing water use in or along the river.

The two other chemical pesticides, alpha and gamma BHC (lindane) were present at or very near the levels of detection. Maximum levels of gamma BHC in individual samples ranged from 0.001 to 0.01 ug/L (Table A4.44). Maximum values for alpha BHC ranged from 0.004 to 0.01 ug/L (Table A4.45). Higher mean levels of both alpha BHC and lindane were recorded for the Alberta border with the levels declining very slightly in a downstream direction. However, more intensive monitoring would be needed to establish if spatial trends of this kind were occurring in the river. The levels of gamma BHC (lindane) observed in the North Saskatchewan River were well below the maximum acceptable concentration specified in the Saskatchewan drinking water quality objectives (Saskatchewan Environment, 1980). The alpha or gamma BHC levels observed in the river are not considered significant in terms of being potentially harmful to aquatic biota or users of the river (Environment Canada, 1979). Similar levels of these variables were reported for the Alberta/Saskatchewan border site by Alberta Environment (1983).

Trace levels of organochlorine pesticides in rivers of agricultural areas on the prairies are not unusual owing to the greater potential for entry of pesticides in high use areas and to the persistent nature of these organochlorine compounds.

3.6 Phenolics

Phenolic substances are organic compounds which are frequently associated with the tainting of the taste and odour of water or flesh of animals living in contaminated water. Some phenolics are highly aromatic and thus may be detected by the human senses of taste and smell when present in very low concentrations (e.g. 0.002 mg/L) in water.

Phenols in high concentrations may be toxic but their main significance in water relates to their taste and odour producing properties. In Saskatchewan water quality objective values of 0.005 mg/L for surface waters and 0.002 mg/L for drinking waters have been established to protect these waters from undesirable tastes and odours.

Phenolics usually are present naturally only at very low levels in undisturbed aquatic environments. In such waters phenolics are derived mainly through their release from decaying plant and animal tissues. Major sources of phenolic compounds in water are usually local with fuel resource industries (coal distillation, oil refineries), chemical plants, animal and human wastes and phenolic pesticide usage being the major anthropogenic sources.

Most of the data concerning phenolic substances in the North Saskatchewan River in Saskatchewan was obtained during the

1981-1982 survey period. Summaries of the long-term (1970-1982) and 1981-1982 data for phenolics are recorded in Tables A3.46 and A3.46 respectively.

Mean levels of phenolics during the 1981-1982 survey period ranged from 2.0 to 6.0 ug/L. Maximum levels of phenolics in individual samples of water from the various monitoring sites ranged from 13 ug/L at the Alberta/Saskatchewan border to 3.0 ug/L at the PAPCO water intake (Table A3.46).

With the exception of the provincial border (Lloydminster Ferry)and Cecil Ferry north stations the mean levels of phenolics at most sites in 1981-1982 were below the existing limit of the surface water quality objective (0.005 mg/L) for Saskatchewan. The relatively high phenolic level recorded at the provincial boundary in the 1981-1982 period was approximately 2.5 times greater than the mean value reported by Alberta Environment (1983) for this site during the period 1977-1981. Additional monitoring would be required to determine if temporal trends were occurring in phenolic levels in the river.

At all stations mean phenolics levels equalled or exceeded the provincial drinking water quality objective of 0.002 mg/L. Water is withdrawn for consumptive use by the Cities of Lloydminster, North Battleford and Prince Albert and by the PAPCO mill. These data suggest that periodic taste/odour problems have been experienced but have mostly been related to high summer algae populations and not to phenolic substances.

The relatively low levels of phenolics observed in the river may be derived in part from chemical and oil refining industrial wastewater discharges in Alberta and at urbanized areas along the river reach in Saskatchewan. Because of the relatively low maximum levels of phenolics observed (Table A4.46) at least part of the observed phenolics may also be attributable to natural sources within the watershed. However, a direct contribution of significant quantities of phenolics by effluent discharges could not be identified.

3.7 Other Variables

In addition to the water quality variables already discussed in the preceding sections several other variables were determined because of their importance to water quality mainly in areas influenced by effluent discharges.

In the City of Prince Albert a wood preserving plant was formerly located on land drained by a storm sewer which discharges to the North Saskatchewan River near 8th Avenue East. Pentachlorophenol (PCP) was employed as a wood preservative at this site and storm water discharged to the river frequently contained elevated levels of this toxic compound. Samples of storm water obtained from this site in 1982 contained PCP at a concentration of 15 mg/L. This storm sewer was inspected and sampled also during the autumn 1983 water quality study of the Prince Albert area of the river and recommendations concerning the maintenance of containment works and corrective measures were made to prevent direct entry of PCP to the river. The subject of PCP in this storm sewer is discussed in detail in the report concerning the 1983 study (Saskatchewan Environment, 1984).

Another water quality variable examined was resin acids. Resin acids are a constituent of pulp mill effluents and are found also in natural aquatic environments as a by-product of woody plant tissue decomposition. They are significant to fisheries in particular. A surface water quality objective level of 0.1 mg/L has been established in Saskatchewan for the protection of aquatic organisms (e.g. fish). Nearly all of the available resin acid data for the upper reach of the river was obtained during the 1981-1982 survey. Mean and range values for resin acid levels at various sites during this period are recorded in Table A3.47.

Mean levels of resin acids during the 1981-1982 period ranged from 0.064 to 3.87 mg/L. The highest mean and maximum levels of resin acids were observed at the Highway 376 monitoring site about 40 Km downstream of North Battleford. Spatial trends in resin acid levels along the river were not apparent, although it is worthy to note that the lowest mean and lowest maximum levels of this variable were observed at the Alberta/Saskatchewan border. Also, as confirmed in another report (Saskatchewan Environment, 1984), the pulp mill effluent did not have a significant influence on the resin acid concentrations in the river.

A summary of annual mean data for resin acids in the river at the Cecil Ferry north monitoring site is presented in Table A5.14, and concerns the period 1976 to 1982. This data suggests an increase in mean levels of resin acids during this period from 0.09 mg/L in 1976 to 0.16 mg/L in 1982. At this location as well as at nine other locations (Table A3.47) the surface water quality objective level of 0.1 mg/L was exceeded. Resin acid levels in the Saskatchewan reach of the river, however, are likely mostly of natural origin.

Finally, determinations of sulphides were also made at selected sites with most of the monitoring for this variable being conducted on the upper reach of the river during the 1981-1982 period.

Sulphides are a natural by-product of the anaerobic decomposition of organic matter. Under anaerobic conditions most of the sulphides are released from decaying material as hydrogen sulphide. Sulphides may also be present in wastewaters discharged by tanneries, chemical and petrochemical industries and by pulp and paper mills. The toxicity of hydrogen sulphide to fish is inversely related to water pH. Relatively little hydrogen sulphide would be present in its most toxic undissociated form at pH 9 but near neutrality (pH 7) the amounts of undissociated and ionic forms of sulphides may be approximately equal.

Hydrogen sulphide is highly soluble and toxic to aquatic organisms. Its presence in water at significant levels is rare because normal pH values in most surface waters in the prairies are near to or above 7 and because sulphide is rapidly oxidized to sulphate in aerobic waters or precipitated from solution by reaction with metals. Frequently however, under winter ice covered conditions anaerobic conditions that may develop in lakes and some rivers may permit the accumulation of hydrogen sulphide and its less toxic ionic forms. Hydrogen sulphide may also contribute a "rotten egg" odour to water and the nearby atmosphere.

In the North Saskatchewan River mean sulphide levels ranged from 0.01 to 0.27 mg/L during the 1981-1982 period (Table A3.48). Mean sulphide levels exceeded the surface water quality objective level of 0.05 mg/L at eight locations.

Generally at these eight locations the sulphide levels in individual samples were below the objective level but a few unusually high individual sample results biased the mean values. Never the less, these results are indicative of unusual but undesirable sulphide levels occurring periodically in the river.

Laboratory error could be responsible but additional sampling would be needed to confirm this. Additional monitoring of the river for sulphides should be conducted to confirm these unusual findings since at the levels of sulphide observed adverse influences on fish and aquatic biota as well as odour problems in water withdrawn for domestic use might be expected to occur. Additional quality control samples should also be analysed to determine the possibility of laboratory error contributing to these unusual results.

The highest sulphide levels (range 0.68 - 3.2 mg/L) in individual samples were recorded for the Cecil Ferry north, Borden Bridge, Highway 21 and Cole Rapids stations during the spring/summer and fall seasons of the 1981-1982 period (Table A4.48). Mean sulphide levels in general were greater at most sites during the spring/summer season than in the winter seasons. This observation of higher sulphide levels occurring during the open water seasons was unexpected since sulphide would not be likely to accumulate to such relatively high levels in well oxygenated waters (eg. Section 3.1.1). The reasons for such a seasonal trend in sulphide levels cannot readily be explained since factors which might contribute to elevated sulphide levels during the open water season would be expected to bring about even higher levels of sulphide in the river water under the low flow and ice-covered conditions of winter.

ACKNOWLEDGEMENTS

The field work involved in the collection of most water quality data presented in this report was conducted by staff of Saskatchewan Environment, Water Pollution Control Branch. The report was drafted by K. P. Lautenschlager. The review comments of staff of the Water Pollution Control Branch were of much assistance in preparing the report in its final form.

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APPENDIX 1

LIST OF WATER USERS ALONG THE NORTH SASKATCHEWAN RIVER

APPENDIX I

NORTH SASKATCHEWAN RIVER: WATER USE DETAILS*

NAME	ADDRESS	LOCATION	STATUS(1)	AREA (Ha)	ALLOCATION (Dam^3)	DIVERSION (Dam^3)
Eaton, D. H.	Frenchman Butte	SE 16-53-27-W3	App - 4	--	--	--
Hutterian Fort Pitt	Lloydminster	NE 6-53-26-W3	Lic - 4	55.6	254	254
Hutterian Fort Pitt	Lloydminster	NE 8-53-26-W3	Lic - 4	17.4	80	80
Husky Oil	Lloydminster	SW 20-51-24-W3	Lic - 3	--	2344	2344
Hudson Bay Oil & Gas	Lloydminster	SE 9-51-24-W3	Lic - 3	--	290	290
Pellizarri Ranch	Paynton	NW 23-48-21-W3	Lic - 4	89.4	410	410
Pellizarri Ranch	Paynton	NE 14-48-21-W3	Lic - 4	78.4	358	358
Texas Gulf	North Battleford	SE 8-46-18-W3	Auth - 3	0	247	247
Kidd Creek Mines Ltd.	North Battleford	SE 8-46-18-W3	Auth - 3	--	432	432
Edwards, F. E.	North Battleford	NW 16-45-17-W3	Lic - 4	5.7	26	0
Ducks Unlimited	North Battleford	SW 12-44-17-W3	Lic - 5	--	--	142
City of North Battleford	North Battleford	SE 12-44-17-W3	Municipal Well Auth	--	--	--
City of North Battleford	North Battleford	NE 1-44-17-W3	Municipal Well Lic	--	432	432
City of North Battleford	North Battleford	NE 1-44-17-W3	Municipal Well Auth	--	--	--
City of North Battleford	North Battleford	NW 06-44-16-W3	Municipal Well Lic	--	234	234
City of North Battleford	North Battleford	NW 6-44-16-W3	Municipal Well Lic	--	234	234
City of North Battleford	North Battleford	NW 6-44-16-W3	Municipal Well Lic	--	185	185

NORTH SASKATCHEWAN RIVER: WATER USE DETAILS*

NAME	ADDRESS	LOCATION	STATUS$^{(1)}$	AREA (Ha)	ALLOCATION (Dam^3)	DIVERSION (Dam^3)
City of North Battleford	North Battleford	NW 6-44-15-W3	Municipal Well Lic	--	123	123
City of North Battleford	North Battleford	NW 6-44-16-W3	Lic - 1	--	893	893
North Battleford Golf Club	North Battleford	SW 33-43-16-W3	Lic - 4	29.1	133	133
North Battleford M. Hospital	North Battleford	NW 28-43-17-W3	N/C	--	--	--
North Battleford M. Hospital	North Battleford	NW 28-43-16-W3	Lic - 5	--	178	178
Town of Battleford	Battleford	NW 29-43-16-3	Municipal Well Lic	--	247	247
Town of Battleford	Battleford	NW 29-43-16-3	Municipal Well Lic	--	12	12
Town of Battleford	Battleford	NW 29-43-16-3	Municipal Well	--	494	494
Westwood, J.	North Battleford	SE 29-43-16-W3	Lic - 4	45.3	138	138
Buchko, T.	Battleford	SE 11-43-16-W3	Auth - 4	47.0	215	215
Sharon Children Home	North Battleford	SE 11-43-16-W3	Lic - 4	10.9	51	51
Hall, R. W.	North Battleford	NW 12-43-16-W3	Lic - 4	12.1	56	56
Hall, R. W.	North Battleford	NW 12-43-16-W3	Lic - 4	28.3	130	130
Hall, R. W.	North Battleford	SE 12-43-16-W3	Auth - 4	47.3	217	217
Thrower, W. J.	Ruddell	NE 34-41-14-W3	Lic - 4	21.9	100	100
Schmidt, W.	Ruddell	SW 32-41-13-W3	Lic - 4	278.5	1273	1273
Gray, G. T.	Maymont	SE 15-41-13-W3	Lic - 4	29.1	133	133
Gray, M.	Maymont	SW 14-41-13-3	Appl - 4	--	--	--
Gray, M.	Maymont	SW 14-41-13-3	Appl - 4	--	--	--

NORTH SASKATCHEWAN RIVER: WATER USE DETAILS*

NAME	ADDRESS	LOCATION	STATUS(1)	AREA (Ha)	ALLOCATION (Dam^3)	DIVERSION (Dam^3)
Pana, B. V.	Sonningdale	SE 11-41-13-W3	Lic - 4	28.3	130	130
Self Reliance and Hard Struggle	Sonningdale	NW 32-40-12-W3	Lic - 3	0	9	9
Keefer, N. E.	Sonningdale	SW 33-40-12-W3	App - 4	--	--	--
Zacker, E.	Arelee	SE 26-39-11-W3	Lic - 4	5.7	26	0
Barth, H.	Radisson	SW 25-39-11-W3	Auth - 4	15.3	70	70
Barth, H.	Radisson	SW 25-39-11-W3	App - 4	--	--	--
Brookman, L. G.	Radisson	SE 25-39-11-W3	App - 4	--	--	--
Krueger, Robert	Borden	SE 18-39-09-3	Auth - 4	179.6	821	821
Kiepen, Alex	Langham	NE 08-39-09-3	Lic - 4	68.9	315	315
Linka, W.	Saskatoon	SE 14-39-9-W3	App - 4	0	0	0
Kasahoff, Joe	Langham	NE 29-39-08-W3	Lic - 4	23.5	107	107
G. Double Bar Farms Limited	Borden	SE 25-39-08-03	Auth - 4	25.0	133	133
Hinde, Harry	Borden	SE 25-39-08-W3	Lic - 4	10.5	48	48
Lamb, Lyle	Hepburn	NE 14-41-07-W3	Auth - 4	31.0	142	142
Chamness, Lawrence	Borden	SE 8-40-07-3	App - 4	--	--	--
Ratzlaff, Albert	Laird	NW 3-43-6-W3	Lic - 4	26.3	54	54
Adrian, Henry Jacob	Waldheim	SE 25-43-6-W3	Lic - 4	3.2	15	15
McLeod Co-op Farm	Prince Albert	NW 3-49-27-W2	Lic - 4	38	174	174
Can. Gov't Corection Service	Prince Albert	NE 1-49-27-W2	Auth - 4	40.9	187	187
K-5 Market Ent.	Prince Albert	SW 12-49-27-2	Lic - 4	16.5	75	75

NORTH SASKATCHEWAN RIVER: WATER USE DETAILS*

NAME	ADDRESS	LOCATION	STATUS(1)	AREA (Ha)	ALLOCATION (Dam^3)	DIVERSION (Dam^3)
Dube, Michel	Prince Albert	SW 07-49-26-W2	Lic - 4	12.7	58	58
City of Prince Albert	Prince Albert	SE 21-48-26-W2	App - 2	--	--	--
City of Prince Albert	Prince Albert	SE 21-48-26-W2	Lic - 2	0	1658	1658
Morgan, Bryn	Prince Albert	NE 11-49-26-W2	Lic - 4	24.7	113	113
Sask. Gov't Highways	Prince Albert	NE 19-48-25-W2	Auth - 5	0	0	0
Zbesheski Farms Ltd.	Prince Albert	SE 33-48-25-W2	Auth - 4	130.8	598	598
McCloy, James	Prince Albert	NE 34-48-25-W2	App - 4	--	--	--
P. A. Pulp	Prince Albert	SW 22-49-25-W2	Lic - 3	0	76538	76538

* Saskatchewan Water
Corporation Data (1984)

(1) STATUS CODE:

Lic - Licensed
App - Application
Auth - Authorized
N/C - Not Completed
1 - Domestic
2 - Municipal
3 - Industrial
4 - Irrigational
5 - Other

APPENDIX 2

SUMMARY OF SAMPLING FREQUENCIES FOR DIFFERENT VARIABLES EXAMINED ON THE NORTH SASKATCHEWAN RIVER DURING 1981-1982

TABLE A2.1: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF NITROGEN, PHOSPHORUS, CARBON, OXYGEN, NON-FILTERABLE RESIDUE, SPECIFIC CONDUCTANCE, POTASSIUM, CALCIUM, MAGNESIUM, SODIUM, SULPHATE, CHLORIDE, HARDNESS, ALKALINITY.

Location	Station Number	1981												1982											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Lloydminster Ferry	1L																		2	1		9	2		
	1M			1		1		9	1			3			3				2	1		1	1		
	1R																		2	1		1	1		
Highway 3 Crossing	5L																		1	1		1	1		
	5M			1		1		9	1			3			3				2	1		1	1		
	5R																		1	1		1	1		
Highway 21 Crossing	8L																		2	1		1	1		
	8M			1		1		3	1			3			3				1	1		1	1		
	8R																		1	1		1	1		
Paynton Ferry	11L																		2	1		1	1		
	11M							9				3			3				2	1		1	1		
	11R																		2	1		1	1		
Highway 16 Crossing (N. Battleford)	15L																		2	1		1	1		
	15M			2		1		10		1		3			3				2	1		1	1		
	15R																		2	1		1	1		
Highway 4 Crossing	19NL																		2						
	19NM																		2			1	1		
	19NR																		2						
	19SL																		2	1					
	19SM							10				3			3				2	1		1	1		
	19SR																		2	1					
Highway 376 Crossing	25L																		2	1		1	1		
	25M			1		1		8		1		3			3				2	1		1	1		
	25R																		2	1		1	1		
Highway 16 Crossing	27L																		3	1		8	8		
	27R	1	1	1		1	2	8	1	2	1	4		1	3	1		1	3	1	1	2	3	2	
Highway 12 Crossing	29L																		1	1		1	1		
	29M					1				1									1	1		1	1		
	29R																		1	1		1	1		
Wingard Ferry	32L																		1	1		1	1		
	32M																		1			1	1		
	32R									1									1			1	1		
Crutwell Ferry	33L																	2	1			1	1		
	33M																	2	1			1	1		
	33R																	2	1			1	1		
Prince Albert WTP Intake	36L																	1							
	36M																	1							
	36R	1	1	1		2	1		1	1	1	1		1	1	1					1			1	1
Prince Albert Pulp Company Intake	42L	1	1							1	1	1		1	1	1					1			1	1
	42M																								
	42R																	3	1						
Cecil Ferry	44L	1	1	1		1	1		1	1	1	1		1	1	1		2	1	1	1	1	1	1	1
	44M																	2	1			1	1		
	44R	1	1	1		1	1		1	1	1	1		1	1	1		2	1	1	1	1	1	1	1
Cole Rapids	46L																	2	1			1	1		
	46M																					1	1		
	46R	1	1	1		1	1		1	1	1	1				1		3	1	1	1	1	1	1	1

(1) This table represents a general summary only - on some occasions samples were not analyzed for certain parameters due to laboratory or field accidents, equipment malfunctions, etc.

TABLE A2.2: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF COLIFORMS _ TOTAL, FECAL: FECAL STREPTOCOCCI (1) (2)

Location	Station Number	1981												1982											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Lloydminster Ferry	1L																		1	1		1	1		
	1M			1		1			1			2			1				1	1		1	1		
	1R																		1	1		1	1		
Highway 3 Crossing	5L																		1	1		1	1		
	5M			1		1			1			2			1				1	1		1	1		
	5R																		1	1		1	1		
Highway 21 Crossing	8L																		1	1		1	1		
	8M			1		1			1			2			1					1		1	1		
	8R																		1	1		1	1		
Paynton Ferry	11L																		1	1		1	1		
	11M											2			1				1	1		1	1		
	11R																		1	1		1	1		
Highway 16 Crossing (N. Battleford)	15L																		1	1		1	1		
	15M			2		1				1		2			1				1	1		1	1		
	15R																		1	1		1	1		
Highway 4 Crossing	19NL																		1						
	19NM																		1			1	1		
	19NR																		1						
	19SL																		1	1					
	19SM											2			1				1	1		1	1		
	19SR																		1	1					
Highway 376 Crossing	25L																		1	1		1	1		
	25M			1		1				1		1			2				1	1		1	1		
	25R																		1	1		1	1		
Highway 16 Crossing	27L																		2	1		2	2		
	27R	1	1	1		1	2		1	2	1	2		1	1	1		1	2	1	1	2	3	2	
Highway 12 Crossing	29L																		1	1		1	1		
	29M					1				1									1	1		1	1		
	29R																		1	1		1	1		
Wingard Ferry	32L																		1	1		1	1		
	32M																		1			1	1		
	32R																		1			1	1		
Crutwell Ferry	33L																	2	1			1	1		
	33M																	2	1			1	1		
	33R																	2	1			1	1		
Prince Albert WTP Intake	36L																	1							
	36M																	1							
	36R	1	1	1		2	1		1	1	1	1		1	1	1					1			1	1
Prince Albert Pulp Company Intake	42L	1	1							1	1	1		1	1	1					1			1	1
	42M																								
	42R																	3	1						
Cecil Ferry	44L	1	1	1		1	1		1	1	1	1		1	1	1		2	1	1	1	1	1	1	1
	44M																	2	1			1	1		
	44R	1	1	1		1	1		1	1	1	1		1	1	1		2	1	1	1	1	1	1	1
Cole Rapids	46L																	2	1			1	1		
	46M																					1	1		
	46R	1	1	1		1	1		1	1	1	1				1	3	1	1	1	1	1	1	1	1

(1) This table represents a general summary only - on some occasions samples were not analyzed for a certain parameter due to laboratory or field accidents, equipment malfunctions, etc.

(2) Analyses by membrane filter or maximum probable number techniques have not been differentiated here.

TABLE A2.3: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF ALUMINUM, ARSENIC, BARIUM, BORON, CADMIUM, CHROMIUM, COBALT, COPPER, CYANIDE, LEAD, MERCURY, MOLYDENUM, NICKEL, SELENIUM, SILVER, URANIUM, VANADIUM, ZINC

Location	Station Number	1981												1982											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Lloydminster Ferry	1L																								
	1M							1							1				1	1		1	1		
	1R																								
Highway 3 Crossing	5L																								
	5M							1							1					1		1	1		
	5R																								
Highway 21 Crossing	8L																								
	8M														1					1		1	1		
	8R																		1						
Paynton Ferry	11L																								
	11M							1							1				1	1		1	1		
	11R																								
Highway 16 Crossing (N. Battleford)	15L																								
	15M							1							1				1	1		1	1		
	15R																								
Highway 4 Crossing	19NL																								
	19NM																		1			1	1		
	19NR																								
	19SL																								
	19SM							1							1				1	1		1	1		
	19SR																								
Highway 376 Crossing	25L																								
	25M							1							1				1	1		1	1		
	25R																								
Highway 16 Crossing	27L																		2			2	1		
	27R					1		1	1			1		1	1			1	1	1	1				
Highway 12 Crossing	29L																			1		1			
	29M																		1			1			
	29R																								
Wingard Ferry	32L																			1					
	32M																		1			1			
	32R																								
Crutwell Ferry	33L																								
	33M																		1			1			
	33R																								
Prince Albert WTP Intake	36L																								
	36M																								
	36R										1			1							1				
Prince Albert Pulp Company Intake	42L											1		1											
	42M																								
	42R																								
Cecil Ferry	44L																								
	44M																		1	1		1			
	44R																								
Cole Rapids	46L																								
	46M																		1			1			
	46R					1										1		1		1					

(1) This table represents a general summary only - on some occasions samples were not analyzed for certain parameters due to laboratory or field accidents, equipment malfunctions, etc.

TABLE A2.4: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF 2,4-D; ALPHA-BHC; GAMMA BHC (LINDANE)

Location	Station Number	1981				1982			
		J F M	A M J	J A S	O N D	J F M	A M J	J A S	O N D
Lloydminster Ferry	1L			1	1	1		1	1
	1M								
	1R								
Highway 3 Crossing	5L								
	5M			1	1	1		1	
	5R								
Highway 21 Crossing	8L								
	8M				1	1		1	
	8R								
Paynton Ferry	11L								
	11M			1	1	1		1	
	11R								
Highway 16 Crossing (N. Battleford)	15L								
	15M			1	1	1		1	
	15R								
Highway 4 Crossing	19NL								
	19NM								
	19NR								
	19SL								
	19SM			1	1	1		1	
	19SR								
Highway 376 Crossing	25L								
	25M			1	1	1		1	
	25R								
Highway 16 Crossing	27L								
	27R	1	1	1 1	2	1 1 1		1 1	2
Highway 12 Crossing	29L								
	29M								
	29R								
Wingard Ferry	32L								
	32M								
	32R								
Crutwell Ferry	33L								
	33M								
	33R								
Prince Albert WTP Intake	36L								
	36M								
	36R								
Prince Albert Pulp Company Intake	42L								
	42M								
	42R								
Cecil Ferry	44L								
	44M								
	44R								
Cole Rapids	46L								
	46M								
	46R	1		1	1				

TABLE A2.5: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF PHENOLIC MATERIAL

Location	Station Number	1981												1982											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Lloydminster Ferry	1L																								
	1M							1				1			1				1	1			1		
	1R																								
Highway 3 Crossing	5L																								
	5M							1				1			1				1	1		1	1		
	5R																								
Highway 21 Crossing	8L																								
	8M											1			1				1	1		1	1		
	8R																								
Paynton Ferry	11L																								
	11M							1				1			1				1	1		1	1		
	11R																								
Highway 16 Crossing (N. Battleford)	15L																								
	15M							1				1			1				1	1			1		
	15R																								
Highway 4 Crossing	19NL																								
	19NM																					1	1		
	19NR																								
	19SL																								
	19SM							1				1			1				1	1		1	1		
	19SR																								
Highway 376 Crossing	25L																								
	25M							1				1			1				1	1		1	1		
	25R																								
Highway 16 Crossing	27L																		1			2	1		
	27R							1				1			1				1	1			1		
Highway 12 Crossing	29L																								
	29M																		1	1		1	1		
	29R																								
Wingard Ferry	32L																			1					
	32M																		1				1		
	32R																					1			
Crutwell Ferry	33L																								
	33M																		1			1	1		
	33R																								
Prince Albert WTP Intake	36L																								
	36M																								
	36R																								
Prince Albert Pulp Company Intake	42L																								
	42M																								
	42R																		1						
Cecil Ferry	44L																			1					
	44M																					1	1		
	44R																								
Cole Rapids	46L																		1						
	46M																					1	1		
	46R																			1					

TABLE A2.6: NUMBER OF SAMPLES COLLECTED FOR ANALYSIS OF RESIN ACIDS: : SULPHIDES (1)

Location	Station Number	1981												1982											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Lloydminster Ferry	1L																								
	1M							1				1			1				1	1		1	1		
	1R																								
Highway 3 Crossing	5L																								
	5M							1				1			1				1	1					
	5R																								
Highway 21 Crossing	8L																								
	8M											1			1				1	1					
	8R																								
Paynton Ferry	11L																								
	11M							1				1			1				1	1					
	11R																								
Highway 16 Crossing (N. Battleford)	15L																								
	15M							1				1			1				1	1					
	15R																								
Highway 4 Crossing	19NL																								
	19NM																		1						
	19NR																								
	19SL																								
	19SM							1				1			1				1	1					
	19SR																								
Highway 376 Crossing	25L							1				1			1				1	1					
	25M																								
	25R																								
Highway 16 Crossing	27L																		2			2	2		
	27R							1			1	2		1	1	1		1	1	1	1		1	2	
Highway 12 Crossing	29L																								
	29M																		1	1		1	1		
	29R																								
Wingard Ferry	32L																			1					
	32M																		1			1	1		
	32R																								
Crutwell Ferry	33L																	2							
	33M																	2	1			1	1		
	33R																	2							
Prince Albert WTP Intake	36L																								
	36M																								
	36R																								
Prince Albert Pulp Company Intake	42L	1	1							1	1	1		1	1	1					1			1	1
	42M																								
	42R																	3	1						
Cecil Ferry	44L	1	1	1		1	1		1	1	1	1		1	1	1		2		1	1			1	1
	44M																	2				1	1		
	44R															1		2							
Cole Rapids	46L																	2	1						
	46M																					1	1		
	46R	1	1	1		1	1		1	1	1	1				1		3		1	1			1	1

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(1) This table represents a general summary only - on some occasions samples were not analyzed for a certain parameter due to laboratory or field accidents, equipment malfunctions, etc.

APPENDIX 3

SUMMARY OF LONG-TERM MEAN, MINIMUM AND MAXIMUM VALUES FOR WATER QUALITY VARIABLES AT STATIONS ALONG THE NORTH SASKATCHEWAN RIVER DURING THE PERIODS 1970-1982, AND 1981-1982

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                TABLE A3.1  Dissolved Oxygen (mg/L)             11:33 THURSDAY, SEPTEMBER 27, 1984    1
          DO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01              44            9.950           5.300           15.400
  05              44           10.059           3.100           15.600
  08              35           10.106           4.600           16.300
  11              16           10.331           5.500           16.000
  15              51            9.116           4.400           15.700
  19              24            9.258           5.300           13.000
  25              39            8.938           3.700           14.100
  27              84            9.631           3.600           16.100
  29              23            9.504           3.800           15.200
  32              10            7.610           2.400           13.600
  33               4            9.825           9.300           10.400
  36             137            9.442           3.500           16.400
  42             149            9.132           2.400           18.000
  44N            170            8.766           3.400           16.300
  44S            162            9.156           1.600           16.100
  46              99            9.270           1.000           16.900
```

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                            SAS                                 11:53 THURSDAY, SEPTEMBER 27, 1984    1
          DO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01              19           10.037           5.300           15.400
  05              17            9.859           3.100           15.600
  08              18           10.061           4.600           16.300
  11              16           10.331           5.500           16.000
  15              24            8.496           4.500           13.100
  19              24            9.258           5.300           13.000
  25              23            8.413           5.100           13.500
  27              38            9.608           5.600           13.400
  29               8            8.300           5.000           13.500
  32               4            8.600           2.400           13.200
  33               4            9.825           9.300           10.400
  36              14           10.321           6.600           14.700
  42              14           10.721           7.000           14.900
  44N             16            9.144           5.700           13.600
  44S             15            9.467           5.800           14.900
  46              18           10.372           5.600           14.500
```

TABLE A3.2 Oxygen Saturation (%)

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   SAT SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER         11:33 FRIDAY, SEPTEMBER 28, 1984    4
                        1970-1982

STATION            SUMN          SUMMEAN          SUMMIN           SUMMAX
  01                 41           86.932            7.300             144
  05                 41           86.444           22.500             120
  08                 30           88.163           34.800             120
  11                 16           96.438           64.000             158
  15                 48           84.029           32.000             122
  19                 24           91.075           60.900             148
  25                 36           80.800           27.000             124
  27                 86           87.008           26.000             148
  29                 22           81.314           28.000             140
  32                  9           64.889           26.000             112
  33                  4           94.750           80.000             108
  36                134           84.578           25.000             137
  42                147           82.029           17.000             156
  44N               169           78.518           25.000             147
  44S               159           81.427            8.000             153
  46                 98           86.316            7.000             136


                      SAS
   SAT SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER          9:43 FRIDAY, SEPTEMBER 28, 1984    4
                        1981-1982

STATION            SUMN          SUMMEAN          SUMMIN           SUMMAX
  01                 18           93.378            7.300             144
  05                 17           92.547           22.500             119
  08                 18           93.017           34.800             120
  11                 16           96.438           64.000             158
  15                 24           81.717           32.500             114
  19                 24           91.075           60.900             148
  25                 23           81.922           38.000             124
  27                 39           89.849           53.200             132
  29                  8           85.237           56.000             140
  32                  4           84.750           27.000             112
  33                  4           94.750           80.000             108
  36                 14           84.579           47.000           127.5
  42                 14           87.557           50.000             118
  44N                16           76.181           41.000          99.000
  44S                15           79.133           44.600             113
  46                 18           90.100           64.000             113
```

TABLE A3.3 Water Temperature (^{o}C)

```
                                     SAS                              13:46 MONDAY, JULY 23, 1984        3
                 TEMP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1970-1982

   STATION               SUMN          SUMMEAN          SUMMIN          SUMMAX
     01                    55            9.300           0.000          22.000
     05                    55            9.545           0.000          26.000
     08                    39            8.974           0.000          22.000
     11                    24           13.625           0.000          22.000
     15                    59           11.258           0.000          23.000
     19                    33           15.515           0.000          22.500
     25                    45           10.827           0.000          24.000
     27                    91            9.749           0.000          24.000
     29                    29            7.552           0.000          20.000
     32                    12            6.958           0.000          20.000
     33                     6           12.000           5.000          20.000
     36                   142            8.479           0.000          26.000
     42                   154            8.601           0.000          29.500
     44N                  175            8.686           0.000          55.000
     44S                  167            8.296           0.000          24.500
     46                   103           10.529           0.000          24.000


                                     SAS                              13:45 MONDAY, JULY 23, 1984        3
                 TEMP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1981-1982

   STATION               SUMN          SUMMEAN          SUMMIN          SUMMAX
     01                    28           13.786           0.000          22.000
     05                    27           13.630           0.000          26.000
     08                    21           11.381           0.000          22.000
     11                    24           13.625           0.000          22.000
     15                    30           14.383           0.000          23.000
     19                    33           15.515           0.000          22.500
     25                    29           14.224           0.000          24.000
     27                    44           11.886           0.000          24.000
     29                    10           14.900           7.000          20.000
     32                     6           13.500           6.000          20.000
     33                     6           12.000           5.000          20.000
     36                    15            6.267           0.000          21.000
     42                    18            7.139           0.000          21.500
     44N                   20            7.925           0.000          22.000
     44S                   18            7.750           0.000          21.000
     46                    21            9.262           0.000          21.000
```

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                      TABLE A3.4  Total Organic Carbon (mg/L)         11:33 THURSDAY, SEPTEMBER 27, 1984     2
               TOC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1970-1982

STATION                SUMN             SUMMEAN             SUMMIN             SUMMAX
  01                     59               7.332              0.000             15.000
  05                     53               8.143              0.000             23.000
  08                     40               6.230              0.000             14.000
  11                     24               7.487              0.000             13.000
  15                     53               7.391              0.000             18.000
  19                     31               6.413              0.000             15.000
  25                     44               7.005              0.000             27.000
  27                     95               7.258              0.000             24.000
  29                     27               7.022              0.900             15.000
  32                     12               5.908              0.900             10.000
  33                     15               7.127              0.900             15.000
  36                    101               9.182              0.900             48.000
  42                     85              10.169              0.000             45.000
  44N                   109              15.178              0.500             45.000
  44S                   106               9.121              0.000             50.000
  46                     82               9.657              0.900             23.000
```

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                                     SAS                              11:53 THURSDAY, SEPTEMBER 27, 1984     2
               TOC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1981-1982

STATION                SUMN             SUMMEAN             SUMMIN             SUMMAX
  01                     37               6.776              0.000             15.000
  05                     25               7.508              0.000             16.000
  08                     22               5.441              0.000             14.000
  11                     24               7.487              0.000             15.000
  15                     31               7.058              0.000             18.000
  19                     31               6.413              0.000             15.000
  25                     28               5.707              0.000             16.000
  27                     54               7.272              0.000             24.000
  29                     14               7.779              0.900             15.000
  32                     10               6.800              2.000             10.000
  33                     15               7.127              0.900             15.000
  36                     12              10.083              2.000             25.000
  42                     15               9.000              2.000             18.000
  44N                    17              12.288              0.900             40.000
  44S                    17               8.176              1.000             22.000
  46                     23               7.083              0.900             19.000
```

```
                 TABLE A3.5  Biochemical Oxygen Demand (mg/L)      11:33 THURSDAY, SEPTEMBER 27, 1984   12
        BOD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1970-1982

STATION            SUMN          SUMMEAN           SUMMIN            SUMMAX
   01                74            2.239            0.200             8.000
   05                63            2.103            0.300             6.500
   08                45            2.033            0.400             5.500
   11                30            2.013            0.600             4.600
   15                68            2.710            0.200            40.000
   19                35            2.583            0.600             5.000
   25                49            2.078            0.400             4.800
   27               111            2.395            0.400            12.000
   29                33            3.003            0.300            13.000
   32                16            2.550            0.400             4.400
   33                12            3.400            2.600             4.200
   36               151            3.142            0.200            40.000
   42               145            2.523            0.100            15.000
   44N              151            6.130            0.600            42.000
   44S              170            2.796            0.000            13.500
   46               111            2.603            0.400             7.000
```

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                              SAS                                   11:53 THURSDAY, SEPTEMBER 27, 1984   12
        BOD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1981-1982

STATION            SUMN          SUMMEAN           SUMMIN            SUMMAX
   01                42            2.438            0.600             8.000
   05                30            2.187            0.600             4.400
   08                24            2.033            0.600             4.800
   11                30            2.013            0.600             4.600
   15                35            2.143            0.600             4.400
   19                35            2.583            0.600             5.000
   25                29            2.269            0.600             4.000
   27                59            2.578            0.600            12.000
   29                13            3.508            2.200             4.600
   32                10            3.560            1.600             4.400
   33                12            3.400            2.600             4.200
   36                18            3.250            0.200            22.000
   42                12            1.342            0.100             4.000
   44N               12            2.733            1.000             4.800
   44S               19            1.853            0.000             5.000
   46                23            2.374            0.400             4.200
```

```
                    TABLE A3.6  Total Kjeldahl Nitrogen (mg/L)       11:33 THURSDAY, SEPTEMBER 27, 1984    3
              TKN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1970-1982

STATION                   SUMN           SUMMEAN             SUMMIN             SUMMAX
   01                       69             0.957              0.200              7.800
   05                       61             0.846              0.100              2.400
   08                       43             0.828              0.200              2.400
   11                       27             0.711              0.100              3.300
   15                       63             1.562              0.100             39.000
   19                       33             0.827              0.100              1.400
   25                       47             0.851              0.200              2.400
   27                      109             0.793              0.100              3.700
   29                       34             1.134              0.300              2.500
   32                       15             0.960              0.400              1.840
   33                       15             1.033              0.400              1.800
   36                      147             1.176              0.100             17.000
   42                      130             1.169              0.200              3.800
   44N                     156             1.338              0.160              5.700
   44S                     156             1.076              0.200              3.700
   46                      107             1.049              0.200             11.400
```

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                                   SAS                               11:53 THURSDAY, SEPTEMBER 27, 1984    3
              TKN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1981-1982

STATION                   SUMN           SUMMEAN             SUMMIN             SUMMAX
   01                       38             0.745              0.400              1.900
   05                       28             0.700              0.200              1.600
   08                       22             0.736              0.200              2.000
   11                       27             0.711              0.100              3.300
   15                       32             0.781              0.100              1.600
   19                       33             0.827              0.100              1.400
   25                       29             0.772              0.200              1.600
   27                       58             0.688              0.100              2.300
   29                       14             0.986              0.600              1.800
   32                       10             0.750              0.600              1.100
   33                       15             1.033              0.400              1.800
   36                       16             1.806              0.200             17.000
   42                       18             0.978              0.200              3.000
   44N                      21             0.852              0.300              2.100
   44S                      21             0.876              0.200              3.400
   46                       27             0.896              0.200              2.200
```

```
                     TABLE A3.7  Nitrate - Nitrogen (mg/L)          11:33 FRIDAY, SEPTEMBER 28, 1984     1
              NO3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1970-1982

STATION              SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                   73            0.261           0.019           0.660
  05                   63            0.289           0.019           0.640
  08                   47            0.284           0.009           0.710
  11                   30            0.153           0.029           0.570
  15                   68            0.275           0.009           1.010
  19                   35            0.247           0.029           1.220
  25                   51            0.228           0.019           0.700
  27                  111            0.291           0.019           5.240
  29                   34            0.281           0.019           0.900
  32                   15            0.294           0.029           0.900
  33                   15            0.388           0.029           1.120
  36                  156            0.296           0.019           1.200
  42                  138            0.332           0.019           3.160
  44N                 163            0.398           0.019          17.300
  44S                 162            0.306           0.009           1.300
  46                  113            0.266           0.019           1.980
```

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                                     SAS                            9:43 FRIDAY, SEPTEMBER 28, 1984     1
              NO3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1981-1982

STATION              SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                   42            0.212           0.029           0.610
  05                   30            0.247           0.029           0.640
  08                   25            0.235           0.029           0.710
  11                   30            0.153           0.029           0.570
  15                   35            0.291           0.029           1.010
  19                   35            0.247           0.029           1.220
  25                   32            0.184           0.029           0.700
  27                   60            0.307           0.029           5.240
  29                   14            0.134           0.029           0.440
  32                   10            0.112           0.029           0.570
  33                   15            0.388           0.029           1.120
  36                   16            0.345           0.029           0.810
  42                   19            0.503           0.029           1.050
  44N                  21            0.431           0.029           1.150
  44S                  21            0.377           0.029           1.010
  46                   27            0.327           0.029           0.980
```

TABLE A3.8 Ammonia - Nitrogen (mg/L)

NH3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SUMN	SUMMEAN	SUMMIN	SUMMAX
01	70	0.247	0.009	1.170
05	62	0.228	0.009	1.100
08	45	0.218	0.009	1.170
11	27	0.096	0.009	0.720
15	65	0.672	0.009	30.800
19	31	0.066	0.009	0.350
25	47	0.166	0.009	0.820
27	113	0.157	0.009	1.150
29	35	0.252	0.010	0.840
32	16	0.271	0.010	0.920
33	15	0.063	0.009	0.240
36	158	0.467	0.009	20.500
42	156	0.351	0.009	2.200
44N	182	0.388	0.009	1.580
44S	180	0.370	0.009	1.570
46	121	0.239	0.009	0.990

SAS
NH3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SUMN	SUMMEAN	SUMMIN	SUMMAX
01	38	0.078	0.009	0.450
05	28	0.080	0.009	0.360
08	22	0.096	0.009	0.380
11	27	0.096	0.009	0.720
15	30	0.066	0.009	0.360
19	31	0.066	0.009	0.350
25	27	0.085	0.009	0.450
27	56	0.061	0.009	0.380
29	14	0.048	0.010	0.220
32	10	0.028	0.010	0.060
33	15	0.063	0.009	0.240
36	16	0.501	0.009	6.200
42	19	0.130	0.009	0.330
44N	21	0.110	0.009	0.380
44S	21	0.116	0.009	0.350
46	27	0.065	0.009	0.320

```
                       TABLE A3.9  Total Phosphorus (mg/L)              11:33 THURSDAY, SEPTEMBER 27, 1984     5
                TP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1970-1982

STATION                  SUMN              SUMMEAN              SUMMIN              SUMMAX
   01                      73                0.130               0.009               0.850
   05                      74                0.140               0.009               0.800
   08                      62                0.158               0.009               1.200
   11                      48                0.186               0.070               1.800
   15                      30                0.298               0.010              10.600
   19                      70                0.623               0.060              14.100
   25                      35                0.162               0.020               1.200
   27                      52                0.139               0.010               1.900
   29                     116                0.125               0.010               0.600
   32                      35                0.096               0.020               0.190
   33                      16                0.203               0.060               0.550
   36                      15                0.100               0.009               2.600
   42                     157                0.102               0.000               0.620
   44N                    157                0.099               0.009               0.500
   44S                    181                0.099               0.009               0.700
   46                     179                0.108               0.000               0.610
                          120
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                                      SAS                                    11:53 THURSDAY, SEPTEMBER 27, 1984     5
                TP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1981-1982

STATION                  SUMN              SUMMEAN              SUMMIN              SUMMAX
   01                      41                0.179               0.060               0.850
   05                      31                0.197               0.050               0.800
   08                      25                0.206               0.070               1.200
   11                      30                0.166               0.070               1.800
   15                      35                0.221               0.070               0.550
   19                      35                0.623               0.060              14.100
   25                      32                0.241               0.080               1.200
   27                      60                0.142               0.040               0.600
   29                      14                0.216               0.040               0.600
   32                      10                0.113               0.060               0.190
   33                      15                0.203               0.060               0.550
   36                      16                0.286               0.040               2.600
   42                      19                0.214               0.060               0.620
   44N                     20                0.141               0.060               0.280
   44S                     21                0.180               0.060               0.700
   46                      27                0.187               0.060               0.610
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                          TABLE A3.10  Ortho Phosphorus (mg/L)               11:33 THURSDAY, SEPTEMBER 27, 1984    6
                  OP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1970-1982

STATION                   SUMN               SUMMEAN               SUMMIN               SUMMAX
  01                        71                0.062                 0.009                 0.700
  05                        61                0.054                 0.009                 0.220
  08                        46                0.059                 0.009                 0.250
  11                        30                0.048                 0.009                 0.220
  15                        65                0.123                 0.000                 5.400
  19                        33                0.043                 0.010                 0.190
  25                        47                0.047                 0.009                 0.240
  27                       112                0.042                 0.000                 0.180
  29                        32                0.034                 0.009                 0.090
  32                        18                0.033                 0.009                 0.100
  33                        15                0.030                 0.009                 0.060
  36                       156                0.048                 0.000                 1.750
  42                       155                0.032                 0.000                 0.200
  44N                      182                0.035                 0.000                 0.380
  44S                      178                0.034                 0.000                 0.140
  46                       121                0.030                 0.000                 0.140



                                       SAS                                   11:53 THURSDAY, SEPTEMBER 27, 1984    6
                  OP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1981-1982

STATION                   SUMN               SUMMEAN               SUMMIN               SUMMAX
  01                        42                0.076                 0.009                 0.700
  05                        31                0.064                 0.009                 0.220
  08                        25                0.070                 0.009                 0.250
  11                        30                0.048                 0.009                 0.220
  15                        33                0.051                 0.010                 0.150
  19                        33                0.043                 0.010                 0.190
  25                        30                0.053                 0.010                 0.240
  27                        58                0.044                 0.009                 0.170
  29                        14                0.029                 0.009                 0.060
  32                        10                0.022                 0.009                 0.050
  33                        15                0.030                 0.009                 0.060
  36                        16                0.112                 0.010                 0.900
  42                        19                0.067                 0.010                 0.150
  44N                       21                0.065                 0.009                 0.380
  44S                       21                0.056                 0.010                 0.140
  46                        27                0.045                 0.009                 0.140
```

TABLE A3.11 pH

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                                   SAS                                13:46 MONDAY, JULY 23, 1984    2
              PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1970-1982

   STATION             SUMN          SUMMEAN          SUMMIN           SUMMAX
     01                  74            8.261           7.300            9.900
     05                  64            8.189           7.500            9.100
     08                  48            8.183           7.500            9.000
     11                  30            8.393           7.300            9.100
     15                  70            8.166           7.400            8.900
     19                  35            8.366           7.500            8.900
     25                  52            8.212           7.600            8.700
     27                 117            8.138           6.900            9.000
     29                  35            8.106           7.300            8.700
     32                  16            8.169           7.400            8.600
     33                  15            8.120           7.200            8.600
     36                 161            8.096           6.900            9.100
     42                 156            7.978           5.400            9.200
     44N                183            7.884           6.700            8.800
     44S                181            8.006           6.200            9.000
     46                 120            8.054           7.100            9.200
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                                   SAS                                13:45 MONDAY, JULY 23, 1984    2
              PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1981-1982

   STATION             SUMN          SUMMEAN          SUMMIN           SUMMAX
     01                  42            8.419           7.400            9.000
     05                  31            8.342           7.500            9.100
     08                  25            8.268           7.500            9.000
     11                  30            8.393           7.300            9.100
     15                  35            8.254           7.400            8.900
     19                  35            8.366           7.500            8.900
     25                  32            8.303           7.600            8.700
     27                  60            8.210           7.000            9.000
     29                  14            8.314           7.500            8.700
     32                  18            8.400           7.400            8.600
     33                  15            8.120           7.200            8.600
     36                  16            7.907           7.100            8.800
     42                  19            7.916           7.500            8.600
     44N                 21            7.918           7.200            8.700
     44S                 21            7.971           7.000            8.800
     46                  27            8.070           7.200            8.600
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                 TABLE A3.12  Total Alkalinity (mg/L)                  11:33 FRIDAY, SEPTEMBER 28, 1984
           TALK SUMMARY GUING DOWNSTREAM OF THE N.SASK.RIVER
                                1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               73           138.29             104             170
  05               64           135.52             100             206
  08               47           139.89             106             200
  11               30              134          90.000             162
  15               70           154.36             116             449
  19               35           135.71          54.000             158
  25               52           146.92             118             206
  27              116           148.17             100             214
  29               35           149.11             116             212
  32               16           151.13             122             208
  33               15           132.47             102             150
  36              158           156.93             108             299
  42              157           162.01          25.000             289
  44N             181           163.27          76.000             400
  44S     [illegible]            155.7          19.000             378
  46              120           152.72             105             214
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                                   SAS                                  9:43 FRIDAY, SEPTEMBER 28, 1984
           TALK SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               42           135.26             104             168
  05               31           130.06             100             162
  08               25           134.88             106             160
  11               30              134          90.000             162
  15               35           142.69             122             166
  19               35           135.71          54.000             158
  25               32            143.5             126             170
  27               60           144.63             100             197
  29               14           136.36             116             151
  32               10            139.2             122             150
  33               15           132.47             102             150
  36               16           167.81             134             232
  42               19           147.50          98.000             282
  44N              21           155.67             108             202
  44S              21            151.9             104             194
  46               27           149.89             105             196
```

TABLE A3.13 Conductivity (uS/cm)

11:33 FRIDAY, SEPTEMBER 28, 1984 3

CUND SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SUMN	SUMMEAN	SUMMIN	SUMMAX
01	74	322.28	190	475
05	65	325.26	200	500
08	48	337.15	210	500
11	30	322.27	260	410
15	70	375.53	190	1100
19	35	346.51	280	418
25	51	355.27	250	500
27	115	379.63	250	1190
29	34	369.21	250	600
32	16	390.19	320	550
33	15	344.27	287	370
36	160	395.74	240	2000
42	157	405.05	190	1400
44N	183	436.67	220	750
44S	181	392.2	200	700
46	120	382.5	200	600

9:43 FRIDAY, SEPTEMBER 28, 1984 3

SAS
CUND SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SUMN	SUMMEAN	SUMMIN	SUMMAX
01	42	319.43	229	450
05	31	316.19	225	500
08	25	334.52	260	500
11	30	322.27	260	410
15	35	370.63	280	720
19	35	346.51	280	418
25	31	354.16	300	500
27	59	378.68	280	1190
29	14	335.93	260	400
32	10	349.3	320	359
33	15	344.27	287	370
36	16	412.06	278	700
42	19	377.53	284	490
44N	21	431.62	278	600
44S	20	396.95	266	700
46	27	378.78	266	532

TABLE A3.14 Total Dissolved Solids (mg/L)

```
                                        SAS                                    13:46 MONDAY, JULY 23, 1984   5
              TDS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1970-1982

STATION                  SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                      40             276.92              224               399
  05                      29             266.66              233               313
  08                      17             275.94              231               380
  11                      25             273.28              229               401
  15                      28             289.46              230               412
  19                      35             284.03              235               348
  25                      27             297.37              238               365
  27                      41             296.95              244               422
  29                      10              279.3              238               401
  32                       7             287.71              250               396
  33                      11             273.91              228               300
  36                       2                348              348               348
  42                      10              321.1              222               521
  44N                      7             344.43              235               565
  44S                      7             336.86              229               506
  46                      11             325.27              234               501
```

```
                                        SAS                                    13:49 MONDAY, JULY 23, 1984   5
              TDS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1981-1982

STATION                  SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                      33             269.48              224               333
  05                      23             262.22              233               313
  08                      15             268.27              231               320
  11                      23             273.2[illegible]    229               401
  15                      25             281.52              230               348
  19                      35             284.03              235               348
  25                      25             294.04              238               360
  27                      37             289.38              244               348
  29                       8             259.38              238               300
  32                       6             269.67              250               290
  33                      11             273.91              228               300
  36                       0                  .                .                 .
  42                       8             273.13              222               316
  44N                      4              272.5              235               314
  44S                      4             266.75              229               287
  46                       7             275.71              234               301
```

TABLE A3.15 Total Hardness (mg/L)

```
      THARD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER        11:33 FRIDAY, SEPTEMBER 28, 1984    6
                               1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               42           171.05            140             220
  05               30           165.87            136             200
  08               20              169            136             212
  11               26           174.31            148             208
  15               30           175.27            144             224
  19               35           172.69            148             216
  25               27           176.59            152             220
  27               44           178.41            148             234
  29               10            161.2            140             216
  32                7           169.71            148             224
  33               11           153.82            124             176
  36                2              214            208             220
  42               10            173.2            124             272
  44N               7           198.57            136             276
  44S               8           177.75            100             268
  46               15           182.93            136             256
```

```
                                  SAS
      THARD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER        9:43 FRIDAY, SEPTEMBER 28, 1984    6
                               1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               35           169.83            140             208
  05               24            164.5            136             200
  08               18           166.67            136             208
  11               26           174.31            148             208
  15               27            172.3            144             212
  19               35           172.69            148             216
  25               25           175.04            152             228
  27               39           175.79            148             224
  29                8              154            140             176
  32                6           160.67            148             176
  33               11           153.82            124             176
  36                0                .              .               .
  42                8              150            124             172
  44N               4              182            136             264
  44S               4              154            124             168
  46                9           159.56            136             180
```

TABLE A3.16 Chloride (mg/L)

```
CL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER          11:33 THURSDAY, SEPTEMBER 27, 1984     7
                   1970-1982

STATION              SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                  74             8.207           0.900          23.000
  05                  65             8.202           1.900          33.000
  08                  48             8.108           1.900          38.000
  11                  30             4.517           1.900          22.000
  15                  70            10.529           1.900             148
  19                  35             3.877           1.900          12.000
  25                  52             7.856           1.900          34.000
  27                 117            11.303           1.900             266
  29                  35            11.540           1.900          40.000
  32                  16            13.938           2.000          46.000
  33                  15             5.600           2.000          18.000
  36                 158            12.429           0.900             312
  42                 157            12.811           1.900             150
  44N                181            25.132           1.900          80.000
  44S                181            11.659           1.900          84.000
  46                 120            11.247           1.900          49.000
```

```
                            SAS
CL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER          11:53 THURSDAY, SEPTEMBER 27, 1984     7
                   1981-1982

STATION              SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                  42             6.133           1.900          20.000
  05                  31             5.148           1.900          12.000
  08                  25             4.932           1.900          12.000
  11                  30             4.517           1.900          22.000
  15                  35             4.666           1.900          16.000
  19                  35             3.877           1.900          12.000
  25                  32             5.487           1.900          18.000
  27                  60            12.500           2.000             266
  29                  14             5.279           1.900          18.000
  32                  10             5.600           2.000          18.000
  33                  15             5.600           2.000          18.000
  36                  16            11.362           1.900          36.000
  42                  19             6.316           2.000          12.000
  44N                 21            20.286           2.000          42.000
  44S                 21             7.610           1.900          22.000
  46                  27            10.222           2.000          34.000
```

```
                         TABLE A3.17  Potassium (mg/L)                      11:33 THURSDAY, SEPTEMBER 27, 1984    8
                K SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1970-1982

STATION              SUMN          SUMMEAN             SUMMIN             SUMMAX
  01                  35            1.543               1.000              3.000
  05                  24            1.542               1.000              2.000
  08                  18            1.778               1.000              2.000
  11                  28            1.679               1.000              2.000
  15                  27            2.037               1.000              3.000
  19                  35            1.943               1.000              3.000
  25                  24            2.292               2.000              3.000
  27                  38            2.026               1.000              3.000
  29                   8            2.750               2.000              4.000
  32                   6            2.333               2.000              4.000
  33                  11            3.455               2.000              5.000
  36                   2            1.000               1.000              1.000
  42                   8            4.875               2.000              7.000
  44N                  5            3.600               2.000              5.000
  44S                  6            5.500               2.000             16.000
  46                  11            3.364               2.000              6.000
```

```
                                    SAS                                     11:53 THURSDAY, SEPTEMBER 27, 1984    8
                K SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                  1981-1982

STATION              SUMN          SUMMEAN             SUMMIN             SUMMAX
  01                  35            1.543               1.000              3.000
  05                  24            1.542               1.000              2.000
  08                  18            1.778               1.000              2.000
  11                  28            1.679               1.000              2.000
  15                  27            2.037               1.000              3.000
  19                  35            1.943               1.000              3.000
  25                  24            2.292               2.000              3.000
  27                  37            2.027               1.000              3.000
  29                   8            2.750               2.000              4.000
  32                   6            2.333               2.000              4.000
  33                  11            3.455               2.000              5.000
  36                   0              .                   .                  .
  42                   8            4.875               2.000              7.000
  44N                  4            3.750               2.000              5.000
  44S                  4            3.750               2.000              5.000
  46                   8            3.875               2.000              6.000
```

TABLE A3.18 Sodium (mg/L)

```
                                                                          11:33 FRIDAY, SEPTEMBER 28, 1984    5
                     NA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1970-1982

                                                                      SUMMIN              SUMMAX
STATION                SUMN           SUMMEAN
  01                     53            10.830                          4.000              26.000
  05                     39            10.205                          4.000              33.000
  08                     29            10.586                          3.000              33.000
  11                     28             7.000                          3.000              10.000
  15                     40            17.150                          4.000                 198
  19                     35             9.486                          4.000              59.000
  25                     34            12.647                          5.000              34.000
  27                     53            15.321                          0.020              41.000
  29                     20            19.350                          8.000              40.000
  32                     10            17.600                          9.000              39.000
  33                     11            12.182                         11.000              14.000
  36                    103            23.856                          7.000                 324
  42                    149            20.188                          6.000              73.000
  44N                   169            28.692                          7.000              60.000
  44S                   120            22.100                          6.000              44.000
  46                    112            18.978                          6.000              54.000
```

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                                                                           9:43 FRIDAY, SEPTEMBER 28, 1984    5
                                          SAS
                     NA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1981-1982

                                                                      SUMMIN              SUMMAX
STATION                SUMN           SUMMEAN
  01                     35             8.029                          4.000              13.000
  05                     24             7.375                          4.000              12.000
  08                     18             6.667                          3.000              11.000
  11                     28             7.000                          3.000              10.000
  15                     27             7.630                          4.000              11.000
  19                     35             9.486                          4.000              59.000
  25                     25             9.600                          5.000              18.000
  27                     37            11.433                          0.020              38.000
  29                      8            10.000                          8.000              13.000
  32                      6            11.000                          9.000              14.000
  33                     11            12.182                         11.000              14.000
  36                      0                 .                              .                   .
  42                     18            12.000                          9.000              16.000
  44N                    19            21.895                          8.000              35.000
  44S                     5            11.200                          9.000              13.000
  46                     21            14.619                          7.000              26.000
```

TABLE A3.19 Magnesium (mg/L)

```
                                                                    11:33 THURSDAY, SEPTEMBER 27, 1984    9
                    MG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1970-1982

STATION              SUMN           SUMMEAN            SUMMIN             SUMMAX
  01                  38            14.763              7.000             20.000
  05                  29            15.310             10.000             21.000
  08                  19            14.579              7.000             21.000
  11                  25            16.080             11.000             24.000
  15                  27            15.111             10.000             21.000
  19                  31            14.935             11.000             20.000
  25                  26            15.077              9.000             21.000
  27                  36            16.833              5.000             29.000
  29                   9            15.667             12.000             19.000
  32                   6            13.667              8.000             17.000
  33                  11            13.818             10.000             17.000
  36                   2            22.000             22.000             22.000
  42                   8            13.125              9.000             17.000
  44N                  5            13.200              8.000             17.000
  44S                  5            14.800              9.000             21.000
  46                  10            16.300             13.000             19.000
```

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                                             SAS                    11:53 THURSDAY, SEPTEMBER 27, 1984    9
                    MG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1981-1982

STATION              SUMN           SUMMEAN            SUMMIN             SUMMAX
  01                  32            14.906              7.000             20.000
  05                  23            14.913             10.000             21.000
  08                  17            14.118              7.000             18.000
  11                  25            16.080             11.000             24.000
  15                  25            15.000             10.000             21.000
  19                  31            14.935             11.000             20.000
  25                  24            14.875              9.000             21.000
  27                  33            16.818              5.000             29.000
  29                   6            15.375             12.000             19.000
  32                   6            13.667              8.000             17.000
  33                  11            13.818             10.000             17.000
  36                   0              .                  .                  .
  42                   8            13.125              9.000             17.000
  44N                  4            13.250              8.000             17.000
  44S                  4            13.250              9.000             16.000
  46                   8            16.000             13.000             19.000
```

TABLE A3.20 Sulphate (mg/L)

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                                                                              11:33 THURSDAY, SEPTEMBER 27, 1984   11
                   SO4 SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1970-1982

STATION                      SUMN               SUMMEAN               SUMMIN               SUMMAX
   01                          53                42.585               20.000               68.000
   05                          40                44.050               20.000               82.000
   08                          28                44.821               28.000               82.000
   11                          26                43.308               24.000               62.000
   15                          41                57.073               20.000                  340
   19                          35                46.543               28.000               71.000
   25                          34                49.971               28.000               78.000
   27                          56                50.589               33.000                  112
   29                          20                59.250               32.000               94.000
   32                          10                53.700               36.000               90.000
   33                          11                49.000               40.000               64.000
   36                         103                60.728               23.000                  230
   42                         148                65.541               20.000                  970
   44N                        169                61.923               18.000                  142
   44S                        118                59.441                9.000                  180
   46                         111                54.360               20.000                  104
```

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                                           SAS                                11:53 THURSDAY, SEPTEMBER 27, 1984   11
                   SO4 SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1981-1982

STATION                      SUMN               SUMMEAN               SUMMIN               SUMMAX
   01                          35                39.829               20.000               60.000
   05                          25                41.400               20.000               59.000
   08                          17                40.118               28.000               60.000
   11                          26                43.308               24.000               62.000
   15                          28                44.214               20.000               68.000
   19                          35                46.543               28.000               71.000
   25                          25                47.600               28.000               65.000
   27                          38                44.474               33.000               63.000
   29                           8                38.250               32.000               44.000
   32                           6                39.333               36.000               40.000
   33                          11                49.000               40.000               64.000
   36                           0                     .                    .                    .
   42                          18                53.167               36.000               72.000
   44N                         19                52.737               38.000               80.000
   44S                          5                41.600               38.000               48.000
   46                          19                48.368               20.000               67.000
```

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                    TABLE A3.21  Calcium (mg/L)                  11:33 THURSDAY, SEPTEMBER 27, 1984   10
           CA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                             1970-1982

 STATION              SUMN           SUMMEAN           SUMMIN           SUMMAX
   01                   39            43.769           32.000           64.000
   05                   29            41.655           32.000           50.000
   08                   19            43.211           34.000           54.000
   11                   25            46.200           29.000              132
   15                   27            44.444           30.000           56.000
   19                   32            44.313           14.000           58.000
   25                   27            45.074           13.000           56.000
   27                   37            41.892           24.000           54.000
   29                    9            37.000           34.000           42.000
   32                    6            40.167           37.000           43.000
   33                   11            39.364           34.000           43.000
   36                    2            48.500           46.000           51.000
   42                    8            39.000           34.000           48.000
   44N                   5            39.800           37.000           45.000
   44S                   5            41.600           35.000           48.000
   46                   10            37.800           32.000           45.000


                             SAS                                 11:53 THURSDAY, SEPTEMBER 27, 1984   10
           CA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                             1981-1982

 STATION              SUMN           SUMMEAN           SUMMIN           SUMMAX
   01                   33            43.273           32.000           53.000
   05                   23            41.609           32.000           50.000
   08                   17            42.882           34.000           54.000
   11                   25            46.200           29.000              132
   15                   25            44.080           30.000           53.000
   19                   32            44.313           14.000           58.000
   25                   25            44.720           13.000           56.000
   27                   34            41.588           24.000           51.000
   29                    8            37.000           34.000           42.000
   32                    6            40.167           37.000           43.000
   33                   11            39.364           34.000           43.000
   36                    0                 .                .                .
   42                    8            39.000           34.000           48.000
   44N                   4            40.500           37.000           45.000
   44S                   4            40.000           35.000           43.000
   46                    8            37.125           32.000           45.000
```

TABLE A3.22 Apparent Colour (colour units)

```
                                        SAS                         13:46 MONDAY, JULY 23, 1984    1
                 APPCOLOR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION              SUMN           SUMMEAN           SUMMIN           SUMMAX
   01                  5             11.000            5.000           20.000
   05                  5              8.600            4.000           19.000
   08                  4              8.250            4.000           20.000
   11                  5              9.600            5.000           13.000
   15                  5             10.000            5.000           14.000
   19                  6             10.833            5.000           17.000
   25                  5              6.810            0.049           13.000
   27                  7              9.857            6.000           15.000
   29                  2             73.500           13.000              134
   32                  2             42.500           14.000           71.000
   33                  1             13.000           13.000           13.000
   36                  2              9.000            5.000           13.000
   42                 14             11.857            6.000           30.000
   44N                20             59.800            9.000              320
   44S                17             12.906            0.900           69.000
   46                 17             18.588            9.000           38.000


                                        SAS                         13:43 MONDAY, JULY 23, 1984    1
                 APPCOLOR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION              SUMN           SUMMEAN           SUMMIN           SUMMAX
   01                  5             11.000            5.000           20.000
   05                  5              8.600            4.000           19.000
   08                  4              8.250            4.000           20.000
   11                  5              9.600            5.000           13.000
   15                  5             10.000            5.000           14.000
   19                  6             10.833            5.000           17.000
   25                  5              6.810            0.049           13.000
   27                  7              9.857            6.000           15.000
   29                  2             73.500           13.000              134
   32                  2             42.500           14.000           71.000
   33                  1             13.000           13.000           13.000
   36                  2              9.000            5.000           13.000
   42                 11              9.364            6.000           17.000
   44N                16             65.563           15.000              320
   44S                14             13.029            0.900           69.000
   46                 13             19.231            9.000           38.000
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                TABLE A3.23  Total Suspended Solids (mg/L)        11:33 FRIDAY, SEPTEMBER 28, 1984    2
          TSS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1970-1982

 STATION            SUMN        SUMMEAN        SUMMIN        SUMMAX
   01                 73         78.548         3.000          1268
   05                 64         85.203         2.000          1470
   08                 47         101.24         3.000          1824
   11                 29         55.034         5.000           317
   15                 66         127.39         4.000          1498
   19                 35         205.74         7.000          1622
   25                 51         99.196         3.000           796
   27                113         57.936         4.000           642
   29                 34         116.65         4.000          1165
   32                 15         39.233         6.000           140
   33                 15          236.6        22.000          1154
   36                155         75.532         4.000          1277
   42                156         121.81         2.000          1564
   44N               181         108.42         3.000          1992
   44S               179         67.783         2.000          1580
   46                121         106.54         3.000          1018


                                 SAS                              9:43 FRIDAY, SEPTEMBER 28, 1984    2
          TSS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                           1981-1982

 STATION            SUMN        SUMMEAN        SUMMIN        SUMMAX
   01                 42         93.500         3.000          1268
   05                 31         125.81         5.000          1470
   08                 25          136.2         5.000          1824
   11                 29         55.034         5.000           317
   15                 35         198.31         4.000          1498
   19                 35         205.74         7.000          1622
   25                 32         137.19         3.000           796
   27                 59         61.831         5.000           642
   29                 14         247.79        23.000          1165
   32                 10         52.400        21.000           140
   33                 15          236.6        22.000          1154
   36                 16         62.313         6.000           550
   42                 19         177.42         6.000           776
   44N                21         103.62         5.000           758
   44S                21         85.381         4.000           670
   46                 27         161.74         6.000           956
```

TABLE A3.24 Turbidity (JTU)

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                                                                        13:46 MONDAY, JULY 23, 1984   4
                                        343
                    TURB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

  STATION                 SUMN          SUMMEAN          SUMMIN          SUMMAX
     01                      8           76.875           1.000             450
     05                      7           85.829           1.500             450
     08                      6           101.78           1.400             490
     11                      8           80.875           1.600             500
     15                      7           89.229           3.900             230
     19                      8           62.150           4.800             160
     25                      7           57.286           3.000             230
     27                      8           15.837           0.700          39.000
     29                      2              135          20.000             250
     32                      2           55.000          17.000          93.000
     33                      7           123.43          19.000             220
     36                      1            2.800           2.800           2.800
     42                      9           111.56           0.009             220
     44N                     3           136.67             100             200
     44S                     2              155             100             210
     46                      6              124          19.000             220
```

```
                                                                        13:45 MONDAY, JULY 23, 1984   4
                                        343
                    TURB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

  STATION                 SUMN          SUMMEAN          SUMMIN          SUMMAX
     01                      8           76.875           1.000             450
     05                      7           85.829           1.500             450
     08                      6           101.78           1.400             490
     11                      8           80.875           1.600             500
     15                      7           89.229           3.900             230
     19                      8           62.150           4.800             160
     25                      7           57.286           3.000             230
     27                      8           15.837           0.700          39.000
     29                      2              135          20.000             250
     32                      2           55.000          17.000          93.000
     33                      7           123.43          19.000             220
     36                      0                .               .               .
     42                      9           111.56           0.009             220
     44N                     3           136.67             100             200
     44S                     2              155             100             210
     46                      6              124          19.000             220
```

```
                    TABLE A3.25  Aluminum, Total (mg/L)              11:33 FRIDAY, SEPTEMBER 28, 1984    11

               AL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            1.567           0.150           6.400
  05               7            1.043           0.070           3.800
  08               6            1.077           0.080           3.000
  11               7            1.243           0.100           3.700
  15               7            1.957           0.070           8.800
  19              10            1.601           0.130           7.000
  25               7            1.289           0.170           3.700
  27              28            0.820           0.130           3.100
  29               4            6.670           0.680          23.000
  32               4            1.545           0.280           3.600
  33               3            1.010           0.630           1.300
  36               1            0.110           0.110           0.110
  42               1            1.600           1.600           1.600
  44N              1            5.200           5.200           5.200
  44S              0             .               .               .
  46              14            1.767           0.260          11.000


                                      SAS                            9:43 FRIDAY, SEPTEMBER 28, 1984    11
               AL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            1.567           0.150           6.400
  05               7            1.043           0.070           3.800
  08               6            1.077           0.080           3.000
  11               7            1.243           0.100           3.700
  15               7            1.957           0.070           8.800
  19              10            1.601           0.130           7.000
  25               7            1.289           0.170           3.700
  27              19            0.797           0.140           1.800
  29               4            6.670           0.680          23.000
  32               4            1.545           0.280           3.600
  33               3            1.010           0.630           1.300
  36               1            0.110           0.110           0.110
  42               1            1.600           1.600           1.600
  44N              1            5.200           5.200           5.200
  44S              0             .               .               .
  46               8            2.460           0.680          11.000
```

TABLE A326 Arsenic, Total (ug/L)

```
                                         SAS                                   11:41 MONDAY, JULY 16, 1984    1
               AS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1970-1982

STATION            SUMN           SUMMEAN            SUMMIN            SUMMAX
  01                  6             1.182             0.490             3.900
  05                  6             1.248             0.490             3.100
  03                  5             1.880             0.700             5.400
  11                  6             0.967             0.500             1.800
  15                  6             1.315             0.490             3.600
  19                  8             1.272             0.490             4.200
  25                  6             0.948             0.490             1.400
  27                 28             1.630             0.490            14.000
  29                  4             2.422             0.490             6.500
  32                  4             1.097             0.490             2.400
  33                  3             0.563             0.490             0.700
  36                  2             0.745             0.490             1.000
  42                  1             0.600             0.600             0.600
  44N                 1             2.800             2.800             2.800
  44S                 0               .                 .                 .
  46                 14             1.604             0.490             4.000
```

```
                                         SAS                                   11:33 MONDAY, JULY 16, 1984    1
               AS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1981-1982

STATION            SUMN           SUMMEAN            SUMMIN            SUMMAX
  01                  6             1.182             0.490             3.900
  05                  6             1.248             0.490             3.100
  08                  5             1.880             0.700             5.400
  11                  6             0.967             0.500             1.800
  15                  6             1.315             0.490             3.600
  19                  8             1.272             0.490             4.200
  25                  6             0.948             0.490             1.400
  27                 19             1.110             0.490             2.900
  29                  4             2.422             0.490             6.500
  32                  4             1.097             0.490             2.400
  33                  3             0.563             0.490             0.700
  36                  1             0.490             0.490             0.490
  42                  1             0.600             0.600             0.600
  44N                 1             2.800             2.800             2.800
  44S                 0               .                 .                 .
  46                  8             1.886             0.490             4.000
```

TABLE A3.27 Barium, Total (mg/L)

```
                                  SAS
         BA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                  9:49 MONDAY, JULY 16, 1984    1
                             1970-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.098              0.060             0.140
  05                   7              0.068              0.005             0.110
  08                   6              0.081              0.066             0.100
  11                   7              0.059              0.028             0.085
  15                   6              0.078              0.008             0.180
  19                   9              0.085              0.024             0.180
  25                   5              0.093              0.069             0.093
  27                  15              0.089              0.044             0.220
  29                   4              0.103              0.065             0.200
  32                   4              0.104              0.068             0.160
  33                   3              0.095              0.070             0.140
  36                   1              0.042              0.042             0.042
  42                   1              0.087              0.037             0.087
  44N                  1              0.140              0.140             0.140
  44S                  0               .                  .                 .
  46                   4              0.167              0.068             0.440
```

```
                                  SAS
         BA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                  9:46 MONDAY, JULY 16, 1984    1
                             1981-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.098              0.060             0.140
  05                   7              0.068              0.005             0.110
  08                   6              0.081              0.066             0.100
  11                   7              0.059              0.028             0.085
  15                   6              0.078              0.008             0.180
  19                   9              0.085              0.024             0.180
  25                   5              0.083              0.068             0.093
  27                  15              0.089              0.044             0.220
  29                   4              0.103              0.065             0.200
  32                   4              0.104              0.068             0.160
  33                   3              0.095              0.070             0.140
  36                   1              0.042              0.042             0.042
  42                   1              0.087              0.087             0.087
  44N                  1              0.140              0.140             0.140
  44S                  0               .                  .                 .
  46                   4              0.167              0.068             0.440
```

TABLE A3.28 Boron, Total (mg/L)

```
                                          SAS
         B SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:49 MONDAY, JULY 16, 1984    2
                             1970-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                    3             0.013              0.009             0.020
  05                    3             0.017              0.010             0.020
  08                    3             0.013              0.009             0.020
  11                    3             0.013              0.009             0.020
  15                    4             0.017              0.010             0.020
  19                    6             0.018              0.009             0.020
  25                    4             0.022              0.009             0.030
  27                   14             0.043              0.010             0.100
  29                    3             0.020              0.009             0.030
  32                    3             0.063              0.020             0.130
  33                    2             0.030              0.020             0.040
  36                    1             0.010              0.019             0.010
  42                    0              .                  .                 .
  44N                   1             0.010              0.010             0.010
  44S                   0              .                  .                 .
  46                    5             0.026              0.009             0.080
```

```
                                          SAS
         B SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:46 MONDAY, JULY 16, 1984    2
                             1981-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                    3             0.013              0.009             0.020
  05                    3             0.017              0.010             0.020
  08                    3             0.013              0.009             0.020
  11                    3             0.013              0.009             0.020
  15                    4             0.017              0.010             0.020
  19                    6             0.018              0.009             0.030
  25                    4             0.022              0.009             0.030
  27                   11             0.035              0.010             0.090
  29                    3             0.020              0.009             0.030
  32                    3             0.063              0.020             0.130
  33                    2             0.030              0.020             0.040
  36                    1             0.010              0.010             0.010
  42                    0              .                  .                 .
  44N                   1             0.010              0.010             0.010
  44S                   0              .                  .                 .
  46                    4             0.012              0.009             0.020
```

TABLE A3.29 Cadmium Total (mg/L)

```
                                        SAS                                9:49 MONDAY, JULY 16, 1984    3
                CD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.001              0.000             0.001
  05                   7              0.001              0.000             0.006
  03                   6              0.001              0.000             0.001
  11                   7              0.006              0.000             0.039
  15                   7              0.001              0.000             0.002
  19                  10              0.001              0.000             0.001
  25                   7              0.001              0.000             0.001
  27                  32              0.015              0.000             0.090
  29                   4              0.001              0.000             0.001
  32                   4              0.001              0.000             0.001
  33                   3              0.001              0.000             0.001
  36                   2              0.001              0.000             0.001
  42                   2              0.045              0.000             0.090
  44N                  1              0.001              0.001             0.001
  44S                  0               .                  .                 .
  46                  15              0.019              0.000             0.090
```

```
                                        SAS                                9:46 MONDAY, JULY 16, 1984    3
                CD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.001              0.000             0.001
  05                   7              0.001              0.000             0.006
  03                   6              0.001              0.000             0.001
  11                   7              0.006              0.000             0.039
  15                   7              0.001              0.000             0.002
  19                  10              0.001              0.000             0.001
  25                   7              0.001              0.000             0.001
  27                  22              0.002              0.000             0.019
  29                   4              0.001              0.000             0.001
  32                   4              0.001              0.000             0.001
  33                   3              0.001              0.000             0.001
  36                   1              0.001              0.001             0.001
  42                   1              0.000              0.000             0.000
  44N                  1              0.001              0.001             0.001
  44S                  0               .                  .                 .
  46                   9              0.005              0.000             0.019
```

TABLE A3.30 Chromium, Total (mg/L)

```
                                        SAS                                9:49 MONDAY, JULY 16, 1984    4
              CR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1970-1982

STATION           SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                 7            0.006           0.002           0.014
  05                 7            0.005           0.001           0.012
  08                 6            0.005           0.003           0.012
  11                 7            0.004           0.002           0.009
  15                 7            0.008           0.003           0.019
  19                10            0.010           0.003           0.022
  25                 7            0.010           0.005           0.019
  27                32            0.011           0.001           0.088
  29                 4            0.013           0.004           0.027
  32                 4            0.027           0.004           0.011
  33                 3            0.007           0.003           0.012
  36                 2            0.002           0.001           0.003
  42                 2            0.008           0.001           0.016
  44N                1            0.014           0.014           0.014
  44S                0              .               .               .
  46                16            0.008           0.001           0.025
```

```
                                        SAS                                9:49 MONDAY, JULY 16, 1984    4
              CR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1981-1982

STATION           SUMN          SUMMEAN          SUMMIN          SUMMAX
  01                 7            0.006           0.002           0.014
  05                 7            0.005           0.001           0.012
  08                 6            0.005           0.003           0.012
  11                 7            0.004           0.002           0.009
  15                 7            0.008           0.003           0.019
  19                10            0.010           0.003           0.022
  25                 7            0.010           0.005           0.019
  27                22            0.011           0.001           0.070
  29                 4            0.013           0.004           0.027
  32                 4            0.007           0.004           0.011
  33                 3            0.007           0.003           0.012
  36                 1            0.003           0.003           0.003
  42                 1            0.001           0.001           0.001
  44N                1            0.014           0.014           0.014
  44S                0              .               .               .
  46                 9            0.010           0.001           0.025
```

```
                    TABLE A3.31  Cobalt, Total (mg/L)
                                   SAS                                  9:49 MONDAY, JULY 16, 1984    5
              CO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                               1970-1982

STATION            SUMN           SUMMEAN           SUMMIN           SUMMAX
  01                  7             0.001            0.001            0.004
  05                  7             0.001            0.001            0.002
  08                  6             0.001            0.001            0.022
  11                  7             0.001            0.001            0.002
  15                  7             0.002            0.001            0.004
  19                 10             0.002            0.001            0.004
  25                  7             0.001            0.001            0.002
  27                 24             0.005            0.001            0.090
  29                  4             0.003            0.001            0.010
  32                  4             0.001            0.001            0.002
  33                  3             0.001            0.001            0.001
  36                  1             0.001            0.001            0.001
  42                  2             0.002            0.001            0.003
  44N                 1             0.002            0.002            0.002
  44S                 0              .                .                .
  46                 11             0.011            0.001            0.090



                                   SAS                                  9:46 MONDAY, JULY 16, 1984    5
              CO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                               1981-1982

STATION            SUMN           SUMMEAN           SUMMIN           SUMMAX
  01                  7             0.001            0.001            0.004
  05                  7             0.001            0.001            0.002
  08                  6             0.001            0.001            0.002
  11                  7             0.001            0.001            0.002
  15                  7             0.002            0.001            0.004
  19                 10             0.002            0.001            0.004
  25                  7             0.001            0.001            0.002
  27                 20             0.001            0.001            0.004
  29                  4             0.003            0.001            0.010
  32                  4             0.001            0.001            0.002
  33                  3             0.001            0.001            0.001
  36                  1             0.001            0.001            0.001
  42                  1             0.001            0.001            0.001
  44N                 1             0.002            0.002            0.002
  44S                 0              .                .                .
  46                  7             0.002            0.001            0.006
```

TABLE A3.32 Copper, Total (mg/L)

```
                                     SAS
            CU SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:49 MONDAY, JULY 16, 1984    6
                                  1970-1982

STATION               SUMN         SUMMEAN         SUMMIN         SUMMAX
  01                    8           0.012           0.005          0.021
  05                    7           0.009           0.005          0.016
  08                    6           0.008           0.006          0.011
  11                    8           0.008           0.005          0.013
  15                    7           0.012           0.003          0.013
  19                   10           0.036           0.005          0.170
  25                    8           0.015           0.008          0.025
  27                   35           0.013           0.002          0.064
  29                    4           0.016           0.007          0.031
  32                    4           0.013           0.008          0.021
  33                    3           0.007           0.007          0.007
  36                    2           0.026           0.004          0.048
  42                    2           0.022           0.007          0.037
  44N                   1           0.016           0.016          0.016
  44S                   0             .               .              .
  46                   16           0.012           0.002          0.035
```

```
                                     SAS
            CU SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:46 MONDAY, JULY 16, 1984    6
                                  1981-1982

STATION               SUMN         SUMMEAN         SUMMIN         SUMMAX
  01                    8           0.012           0.005          0.021
  05                    7           0.009           0.005          0.016
  08                    6           0.008           0.006          0.011
  11                    8           0.008           0.005          0.013
  15                    7           0.012           0.003          0.013
  19                   10           0.036           0.005          0.170
  25                    8           0.015           0.008          0.025
  27                   25           0.012           0.002          0.064
  29                    4           0.016           0.007          0.031
  32                    4           0.013           0.008          0.021
  33                    3           0.007           0.007          0.007
  36                    1           0.004           0.004          0.004
  42                    1           0.037           0.037          0.037
  44N                   1           0.016           0.016          0.016
  44S                   0             .               .              .
  46                    9           0.011           0.002          0.028
```

TABLE A3.33 Cyanide, Total (ug/L)

```
                                       SAS                       11:41 MONDAY, JULY 1[illegible], 19[illegible]      2
                  CN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.811            0.090           3.000
  05               7            2.770            0.090          13.000
  08               6            0.530            0.090           1.500
  11               7            1.326            0.090           5.500
  15               7            4.241            0.090          12.000
  19              10            1.839            0.090           6.000
  25               7            3.013            0.090          16.000
  27              25            1.869            0.090           9.000
  29               4            2.872            0.090           7.000
  32               4            2.075            0.800           4.500
  33               3            0.093            0.090           0.100
  36               1            0.700            0.700           0.700
  42               1            0.090            0.090           0.090
  44N              1            8.000            8.000           8.000
  44S              0              .                .               .
  46              13            1.618            0.090           6.000
```

```
                                       SAS                       11:3[illegible] MONDAY, JULY 1[illegible], 19[illegible]      2
                  CN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.811            0.090           3.000
  05               7            2.770            0.090          13.000
  08               6            0.530            0.090           1.500
  11               7            1.326            0.090           5.500
  15               7            4.241            0.090          12.000
  19              10            1.839            0.090           6.000
  25               7            3.013            0.090          16.000
  27              19            2.224            0.090           9.000
  29               4            2.872            0.090           7.000
  32               4            2.075            0.800           4.500
  33               3            0.093            0.090           0.100
  36               1            0.700            0.700           0.700
  42               1            0.090            0.090           0.090
  44N              1            8.000            8.000           8.000
  44S              0              .                .               .
  46               3            1.572            0.090           6.000
```

TABLE A3.34 Lead, Total (mg/L)

```
                                            SAS
          PB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              7:47 MONDAY, JULY 16, 1984     7
                                         1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.006            0.002           0.016
  05               7            0.006            0.002           0.013
  08               6            0.007            0.002           0.014
  11               7            0.004            0.002           0.007
  15               7            0.009            0.003           0.022
  19              10            0.010            0.002           0.026
  25               7            0.009            0.004           0.019
  27              32            0.009            0.002           0.068
  29               4            0.005            0.005           0.006
  32               4            0.007            0.004           0.014
  33               3            0.005            0.004           0.005
  36               2            0.003            0.002           0.005
  42               2            0.005            0.002           0.008
  44N              1            0.005            0.005           0.005
  44S              0              .                .               .
  46              16            0.011            0.002           0.043
```

```
                                            SAS
          PB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              7:55 MONDAY, JULY 16, 1984     7
                                         1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.006            0.002           0.016
  05               7            0.006            0.002           0.013
  08               6            0.007            0.001           0.014
  11               7            0.004            0.002           0.007
  15               7            0.009            0.003           0.022
  19              10            0.010            0.002           0.026
  25               7            0.009            0.004           0.019
  27              22            0.009            0.002           0.068
  29               4            0.005            0.005           0.006
  32               4            0.007            0.004           0.014
  33               3            0.005            0.004           0.005
  36               1            0.005            0.005           0.005
  42               1            0.008            0.008           0.008
  44N              1            0.005            0.005           0.005
  44S              0              .                .               .
  46               9            0.011            0.002           0.043
```

TABLE A3.35 Mercury, Total (ug/L)

```
                                        SAS
          HG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER             11:41 MONDAY, JULY 16, 1984     3
                                     1970-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.057              0.019             0.250
  05                   7              0.052              0.019             0.210
  08                   6              0.021              0.019             0.030
  11                   7              0.063              0.019             0.260
  15                   7              0.051              0.019             0.240
  19                  10              0.048              0.019             0.200
  25                   7              0.058              0.019             0.270
  27                  30              0.065              0.019             0.350
  29                   4              0.019              0.019             0.020
  32                   4              0.024              0.019             0.040
  33                   3              0.017              0.019             0.020
  36                  15              0.076              0.019             0.200
  42                  10              0.066              0.019             0.099
  44N                  1              0.040              0.040             0.040
  44S                  0                .                  .                 .
  46                  19              0.077              0.019             0.250
```

```
                                        SAS
          HG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER             11:19 MONDAY, JULY 16, 1984     3
                                     1981-1982

STATION              SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                   7              0.057              0.019             0.250
  05                   7              0.052              0.019             0.210
  08                   6              0.021              0.019             0.030
  11                   7              0.063              0.019             0.260
  15                   7              0.051              0.019             0.240
  19                  10              0.048              0.019             0.200
  25                   7              0.059              0.019             0.270
  27                  20              0.053              0.019             0.350
  29                   4              0.019              0.019             0.020
  32                   4              0.024              0.019             0.040
  33                   3              0.019              0.019             0.020
  36                   5              0.035              0.019             0.090
  42                   3              0.020              0.019             0.020
  44N                  1              0.040              0.040             0.040
  44S                  0                .                  .                 .
  46                   9              0.054              0.019             0.220
```

TABLE A3.36 Molybdenum, Total (mg/L)

```
                                        SAS                                    9:54 MONDAY, JULY 16, 1984     2
                   MO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION                 SUMN              SUMMEAN              SUMMIN              SUMMAX
   01                      7                0.005               0.005               0.005
   05                      7                0.005               0.005               0.005
   08                      6                0.005               0.005               0.005
   11                      7                0.005               0.005               0.005
   15                      7                0.005               0.002               0.006
   19                     10                0.005               0.002               0.005
   25                      7                0.004               0.002               0.005
   27                     15                0.005               0.002               0.005
   29                      4                0.008               0.005               0.017
   32                      4                0.005               0.005               0.005
   33                      3                0.005               0.005               0.005
   36                      1                0.005               0.005               0.005
   42                      1                0.005               0.005               0.005
   44N                     1                0.005               0.005               0.005
   44S                     0                  .                   .                   .
   46                      4                0.006               0.005               0.010
```

```
                                        SAS                                    9:37 MONDAY, JULY 16, 1984     1
                   MO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION                 SUMN              SUMMEAN              SUMMIN              SUMMAX
   01                      7                0.005               0.005               0.005
   05                      7                0.005               0.005               0.005
   08                      6                0.005               0.005               0.005
   11                      7                0.005               0.005               0.005
   15                      7                0.005               0.002               0.006
   19                     10                0.005               0.002               0.005
   25                      7                0.004               0.002               0.005
   27                     15                0.005               0.002               0.005
   29                      4                0.008               0.005               0.017
   32                      4                0.005               0.005               0.005
   33                      3                0.005               0.005               0.005
   36                      1                0.005               0.005               0.005
   42                      1                0.005               0.005               0.005
   44N                     1                0.005               0.005               0.005
   44S                     0                  .                   .                   .
   46                      4                0.006               0.005               0.010
```

TABLE A3.37 Nickel, Total (mg/L)

```
                                      SAS                                  9:54 MONDAY, JULY 16, 1984   5
            NI SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.009            0.003           0.017
  05               7            0.007            0.004           0.016
  08               6            0.006            0.002           0.012
  11               7            0.020            0.002           0.110
  15               7            0.011            0.002           0.038
  19              10            0.016            0.002           0.068
  25               7            0.022            0.004           0.120
  27              29            0.020            0.001           0.210
  29               4            0.013            0.006           0.032
  32               4            0.007            0.003           0.010
  33               3            0.003            0.003           0.004
  36               2            0.003            0.001           0.005
  42               2            0.005            0.005           0.006
  44N              1            0.012            0.012           0.012
  44S              0              .                .               .
  46              15            0.010            0.001           0.026
```

```
                                      SAS                                  9:37 MONDAY, JULY 16, 1984   5
            NI SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1991-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.009            0.003           0.017
  05               7            0.007            0.004           0.016
  08               6            0.006            0.002           0.012
  11               7            0.020            0.002           0.110
  15               7            0.011            0.002           0.038
  19              10            0.016            0.002           0.068
  25               7            0.022            0.004           0.120
  27              22            0.021            0.001           0.210
  29               4            0.013            0.006           0.032
  32               4            0.007            0.003           0.010
  33               3            0.003            0.003           0.004
  36               1            0.001            0.001           0.001
  42               1            0.006            0.006           0.006
  44N              1            0.012            0.012           0.012
  44S              0              .                .               .
  46               9            0.010            0.001           0.026
```

TABLE A3.38 Selenium, Total (mg/L)

```
                                            SAS                                  9:54 MONDAY, JULY 16, 1984      3
                   SE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1970-1982

STATION               SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                     3              0.003             0.001             0.009
  05                     5              0.003             0.001             0.009
  08                     4              0.003             0.001             0.009
  11                     5              0.003             0.001             0.009
  15                     5              0.003             0.001             0.009
  19                     6              0.003             0.001             0.009
  25                     5              0.003             0.001             0.009
  27                    10              0.004             0.001             0.009
  29                     2              0.005             0.001             0.009
  32                     2              0.005             0.001             0.009
  33                     1              0.001             0.001             0.001
  36                     1              0.001             0.001             0.001
  42                     1              0.001             0.001             0.001
  44N                    1              0.009             0.009             0.009
  44S                    0               .                 .                 .
  46                     2              0.005             0.001             0.009
```

```
                                            SAS                                  9:17 MONDAY, JULY 16, 1984      3
                   SE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1931-1982

STATION               SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                     3              0.003             0.001             0.009
  05                     5              0.003             0.001             0.009
  08                     4              0.003             0.001             0.009
  11                     5              0.003             0.001             0.009
  15                     5              0.003             0.001             0.009
  19                     6              0.003             0.001             0.009
  25                     5              0.003             0.001             0.009
  27                    10              0.004             0.001             0.009
  29                     2              0.005             0.001             0.009
  32                     2              0.005             0.001             0.009
  33                     1              0.001             0.001             0.001
  36                     1              0.001             0.001             0.001
  42                     1              0.001             0.001             0.001
  44N                    1              0.009             0.009             0.009
  44S                    0               .                 .                 .
  46                     2              0.005             0.001             0.009
```

TABLE A3.39 Silver, Total (mg/L)

```
                                        SAS                                     9:54 MONDAY, JULY 16, 1984    6
              AG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
01                  3            0.001           0.001           0.001
05                  3            0.001           0.001           0.001
08                  3            0.002           0.001           0.003
11                  3            0.001           0.001           0.001
15                  3            0.001           0.001           0.001
19                  5            0.001           0.001           0.002
25                  3            0.001           0.001           0.001
27                 12            0.016           0.001           0.030
29                  3            0.001           0.001           0.001
32                  3            0.002           0.001           0.002
33                  2            0.001           0.001           0.001
36                  2            0.000           0.000           0.001
42                  1            0.090           0.090           0.090
44N                 1            0.001           0.001           0.001
44S                 0                .               .               .
46                  4            0.023           0.001           0.090
```

```
                                        SAS                                     9:37 MONDAY, JULY 16, 1984    6
              AG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
01                  3            0.001           0.001           0.001
05                  3            0.001           0.001           0.001
08                  3            0.002           0.001           0.003
11                  3            0.001           0.001           0.001
15                  3            0.001           0.001           0.001
19                  5            0.001           0.001           0.002
25                  3            0.001           0.001           0.001
27                 10            0.001           0.001           0.002
29                  3            0.001           0.001           0.001
32                  3            0.002           0.001           0.002
33                  2            0.001           0.001           0.001
36                  1            0.001           0.001           0.001
42                  0                .               .               .
44N                 1            0.001           0.001           0.001
44S                 0                .               .               .
46                  3            0.001           0.001           0.001
```

TABLE A3.40 Uranium, Total (ug/L)

```
                                   SAS                                    9:54 MONDAY, JULY 16, 1984    7
        U SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                               1970-1982

STATION            SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                 1              0.010              0.010             0.010
  05                 1              0.010              0.010             0.010
  08                 1              0.010              0.010             0.010
  11                 1              0.010              0.010             0.010
  15                 1              0.010              0.010             0.010
  19                 1              0.010              0.010             0.010
  25                 1              0.010              0.010             0.010
  27                 4              0.010              0.009             0.010
  29                 1              0.010              0.010             0.010
  32                 1              0.010              0.010             0.010
  33                 0               .                  .                 .
  36                 1              2.300              2.300             2.300
  42                 0               .                  .                 .
  44N                1              0.010              0.010             0.010
  44S                0               .                  .                 .
  46                 1              0.010              0.010             0.010


                                   SAS                                    9:37 MONDAY, JULY 16, 1984    7
        U SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                               1981-1982

STATION            SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                 1              0.010              0.010             0.010
  05                 1              0.010              0.010             0.010
  08                 1              0.010              0.010             0.010
  11                 1              0.010              0.010             0.010
  15                 1              0.010              0.010             0.010
  19                 1              0.010              0.010             0.010
  25                 1              0.010              0.010             0.010
  27                 4              0.010              0.009             0.010
  29                 1              0.010              0.010             0.010
  32                 1              0.010              0.010             0.010
  33                 0               .                  .                 .
  36                 1              2.300              2.300             2.300
  42                 0               .                  .                 .
  44N                1              0.010              0.010             0.010
  44S                0               .                  .                 .
  46                 1              0.010              0.010             0.010
```

TABLE A3.41 Vanadium, Total (mg/L)

```
                                          SAS                                    9:54 MONDAY, JULY 16, 1984    9
                  V SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                       1970-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.011            0.009           0.020
  05               7            0.009            0.009           0.010
  09               6            0.009            0.009           0.010
  11               7            0.009            0.009           0.009
  15               7            0.010            0.003           0.020
  19              10            0.010            0.004           0.020
  25               7            0.008            0.004           0.009
  27              15            0.009            0.004           0.010
  29               4            0.017            0.009           0.040
  32               4            0.009            0.009           0.010
  33               3            0.009            0.009           0.009
  36               1            0.009            0.009           0.009
  42               1            0.009            0.009           0.009
  44N              1            0.020            0.020           0.020
  44S              0             .                .               .
  46               4            0.013            0.009           0.027
```

```
                                          SAS                                    9:37 MONDAY, JULY 16, 1984    9
                  V SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                       1981-1982

STATION          SUMN          SUMMEAN          SUMMIN          SUMMAX
  01               7            0.011            0.009           0.020
  05               7            0.009            0.009           0.010
  08               6            0.009            0.009           0.010
  11               7            0.009            0.009           0.009
  15               7            0.010            0.003           0.020
  19              10            0.010            0.004           0.020
  25               7            0.008            0.004           0.009
  27              15            0.009            0.004           0.010
  29               4            0.017            0.009           0.040
  32               4            0.009            0.009           0.010
  33               3            0.007            0.009           0.009
  36               1            0.009            0.009           0.009
  42               1            0.009            0.009           0.009
  44N              1            0.020            0.020           0.020
  44S              0             .                .               .
  46               4            0.013            0.009           0.027
```

TABLE A3.42 Zinc, Total (mg/L)

```
                                                   SAS
                     ZN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:54 MONDAY, JULY 16, 1984    4
                                          1970-1982

STATION            SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                  7              0.110             0.004             0.500
  05                  7              0.032             0.005             0.082
  08                  6              0.065             0.013             0.230
  11                  7              0.066             0.008             0.360
  15                  7              0.051             0.005             0.120
  19                 10              0.140             0.012             0.670
  25                  7              0.026             0.005             0.065
  27                 32              0.071             0.005             0.360
  29                  4              0.041             0.021             0.087
  32                  4              0.018             0.007             0.030
  33                  3              0.028             0.012             0.047
  36                  2              0.035             0.001             0.069
  42                  2              0.073             0.054             0.090
  44N                 1              0.022             0.022             0.022
  44S                 0              .                 .                 .
  46                 16              0.050             0.008             0.150
```

```
                                                   SAS
                     ZN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER              9:37 MONDAY, JULY 16, 1984    4
                                          1981-1982

STATION            SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                  7              0.110             0.004             0.500
  05                  7              0.032             0.005             0.082
  08                  6              0.065             0.013             0.230
  11                  7              0.066             0.008             0.360
  15                  7              0.051             0.005             0.120
  19                 10              0.140             0.012             0.670
  25                  7              0.026             0.005             0.065
  27                 22              0.049             0.005             0.310
  29                  4              0.041             0.021             0.087
  32                  4              0.018             0.007             0.030
  33                  3              0.028             0.012             0.047
  36                  1              0.069             0.069             0.069
  42                  1              0.056             0.056             0.056
  44N                 1              0.022             0.022             0.022
  44S                 0              .                 .                 .
  46                  9              0.051             0.008             0.150
```

TABLE A3.43 2,4-D (ug/L)

```
                                          SAS                                        9:49 MONDAY, JULY 16, 1984     9
             TWOFOURD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1970-1982

STATION                  SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                       5              0.109              0.010             0.300
  05                       4              0.076              0.004             0.100
  08                       3              0.067              0.030             0.100
  11                       4              0.004              0.004             0.004
  15                       4              0.057              0.004             0.200
  19                       4              0.004              0.004             0.004
  25                       5              0.015              0.004             0.060
  27                      16              0.104              0.004             0.400
  29                       0               .                  .                 .
  32                       0               .                  .                 .
  33                       0               .                  .                 .
  36                       0               .                  .                 .
  42                       0               .                  .                 .
  44N                      0               .                  .                 .
  44S                      0               .                  .                 .
  46                       7              0.129              0.004             0.490


                                          SAS                                        9:46 MONDAY, JULY 16, 1984     9
             TWOFOURD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1981-1982

STATION                  SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                       5              0.108              0.010             0.300
  05                       4              0.076              0.004             0.100
  08                       3              0.067              0.030             0.100
  11                       4              0.004              0.004             0.004
  15                       4              0.057              0.004             0.200
  19                       4              0.004              0.004             0.004
  25                       4              0.004              0.004             0.004
  27                      13              0.073              0.004             0.300
  29                       0               .                  .                 .
  32                       0               .                  .                 .
  33                       0               .                  .                 .
  36                       0               .                  .                 .
  42                       0               .                  .                 .
  44N                      0               .                  .                 .
  44S                      0               .                  .                 .
  46                       3              0.103              0.004             0.300
```

TABLE A3.44 Gamma BHC (lindane)(ug/L)

```
                                             SAS                                    9:49 MONDAY, JULY 16, 1984     9
                  LINDANE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                       1970-1982

STATION                    SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                          4              0.003             0.001             0.010
  05                          4              0.001             0.001             0.002
  08                          3              0.001             0.001             0.001
  11                          4              0.001             0.001             0.003
  15                          4              0.001             0.001             0.001
  19                          4              0.001             0.001             0.001
  25                          5              0.001             0.001             0.002
  27                         14              0.001             0.001             0.009
  29                          0                .                 .                 .
  32                          0                .                 .                 .
  33                          0                .                 .                 .
  36                          0                .                 .                 .
  42                          0                .                 .                 .
  44N                         0                .                 .                 .
  44S                         0                .                 .                 .
  46                          6              0.001             0.001             0.001


                                             SAS                                    9:46 MONDAY, JULY 16, 1984     9
                  LINDANE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                       1981-1992

STATION                    SUMN            SUMMEAN            SUMMIN            SUMMAX
  01                          4              0.003             0.001             0.010
  05                          4              0.001             0.001             0.002
  08                          3              0.001             0.001             0.001
  11                          4              0.001             0.001             0.003
  15                          4              0.001             0.001             0.001
  19                          4              0.001             0.001             0.001
  25                          4              0.001             0.001             0.002
  27                         11              0.002             0.001             0.008
  29                          0                .                 .                 .
  32                          0                .                 .                 .
  33                          0                .                 .                 .
  36                          0                .                 .                 .
  42                          0                .                 .                 .
  44N                         0                .                 .                 .
  44S                         0                .                 .                 .
  46                          3              0.001             0.001             0.001
```

TABLE A3.45 Alpha BHC (ug/L)

```
                                            SAS                                      9:54 MONDAY, JULY 16, 1984     9
                  ALPHABHC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1970-1982

STATION                  SUMN              SUMMEAN              SUMMIN              SUMMAX
  01                        4                0.006               0.003               0.010
  05                        4                0.004               0.002               0.007
  08                        3                0.003               0.001               0.004
  11                        4                0.004               0.002               0.005
  15                        4                0.003               0.001               0.005
  19                        4                0.003               0.002               0.005
  25                        5                0.003               0.002               0.005
  27                       14                0.003               0.001               0.010
  29                        0                  .                   .                   .
  32                        0                  .                   .                   .
  33                        0                  .                   .                   .
  36                        0                  .                   .                   .
  42                        0                  .                   .                   .
  44N                       0                  .                   .                   .
  44S                       0                  .                   .                   .
  46                        6                0.007               0.002               0.020
```

```
                                            SAS                                      9:37 MONDAY, JULY 16, 1984     9
                  ALPHABHC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1991-1982

STATION                  SUMN              SUMMEAN              SUMMIN              SUMMAX
  01                        4                0.006               0.003               0.010
  05                        4                0.004               0.002               0.007
  08                        3                0.003               0.001               0.004
  11                        4                0.004               0.002               0.005
  15                        4                0.003               0.001               0.005
  19                        4                0.003               0.002               0.005
  25                        4                0.003               0.002               0.005
  27                       11                0.004               0.001               0.010
  29                        0                  .                   .                   .
  32                        0                  .                   .                   .
  33                        0                  .                   .                   .
  36                        0                  .                   .                   .
  42                        0                  .                   .                   .
  44N                       0                  .                   .                   .
  44S                       0                  .                   .                   .
  46                        3                0.004               0.002               0.006
```

```
                    TABLE A3.46  Phenolics (ug/L)                    11:33 FRIDAY, SEPTEMBER 28, 1984     8
            PHENOLS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1970-1982

STATION               SUMN            SUMMEAN           SUMMIN           SUMMAX
  01                    6              5.500             3.000           13.000
  05                    7              2.714             1.000            5.000
  08                    6              3.083             1.000            5.000
  11                    7              4.499             0.490            9.000
  15                    7              3.357             2.000            4.000
  19                   10              4.400             2.000            9.000
  25                    7              4.857             2.000            9.000
  27                   11              3.818             1.000            9.000
  29                    5              2.260             1.300            3.000
  32                    4              2.000             1.000            3.000
  33                    3              2.000             1.000            4.000
  36                    1              6.000             6.000            6.000
  42                    1              3.000             3.000            3.000
  44N                   1              6.000             6.000            6.000
  44S                   0               .                 .                .
  46                    4              4.250             2.000            6.000
```

```
                               SAS                                   9:43 FRIDAY, SEPTEMBER 28, 1984     8
            PHENOLS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                1981-1982

STATION               SUMN            SUMMEAN           SUMMIN           SUMMAX
  01                    6              5.500             3.000           13.000
  05                    7              2.714             1.000            5.000
  08                    6              3.083             1.000            5.000
  11                    7              4.499             0.490            9.000
  15                    6              3.500             2.000            4.000
  19                   10              4.400             2.000            9.000
  25                    7              4.857             2.000            9.000
  27                   10              4.000             1.000            9.000
  29                    4              2.500             2.000            3.000
  32                    4              2.000             1.000            3.000
  33                    3              2.000             1.000            4.000
  36                    0               .                 .                .
  42                    1              3.000             3.000            3.000
  44N                   1              6.000             6.000            6.000
  44S                   0               .                 .                .
  46                    4              4.250             2.000            6.000
```

TABLE A3.47 Resin Acids (mg/L)

```
                                                                11:33 FRIDAY, SEPTEMBER 28, 1984    9
                   RA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1970-1982

STATION              SUMN           SUMMEAN            SUMMIN             SUMMAX
  01                    7             0.064             0.049              0.110
  05                    6             0.201             0.049              0.800
  08                    4             0.072             0.049              0.120
  11                    5             0.109             0.049              0.310
  15                    5             0.392             0.049              1.500
  19                    6             0.331             0.049              1.400
  25                    5             3.870             0.060             11.000
  27                   20             0.560             0.049              8.900
  29                    4             0.102             0.049              0.160
  32                    4             0.094             0.049              0.150
  33                    9             0.072             0.049              0.120
  36                    0               .                 .                  .
  42                   40             0.194             0.049              1.100
  44N                  47             0.400             0.049              6.300
  44S                   3             0.059             0.049              0.080
  46                   40             0.259             0.019              1.900
```

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                                                                 9:43 FRIDAY, SEPTEMBER 28, 1984    9
                   RA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                      1981-1982

STATION              SUMN           SUMMEAN            SUMMIN             SUMMAX
  01                    7             0.064             0.049              0.110
  05                    5             0.082             0.049              0.150
  08                    4             0.072             0.049              0.120
  11                    5             0.109             0.049              0.310
  15                    5             0.392             0.049              1.500
  19                    6             0.331             0.049              1.400
  25                    5             3.870             0.060             11.000
  27                   20             0.560             0.049              8.900
  29                    4             0.102             0.049              0.160
  32                    4             0.094             0.049              0.150
  33                    9             0.072             0.049              0.120
  36                    0               .                 .                  .
  42                   19             0.100             0.049              0.310
  44N                  18             0.515             0.049              6.300
  44S                   3             0.059             0.049              0.080
  46                   20             0.231             0.019              1.900
```

TABLE A3.48 Sulphide (mg/L)

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SULPHIDE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER 11:33 FRIDAY, SEPTEMBER 28, 1984   1
                       1970-1982

STATION          SUMN        SUMMEAN        SUMMIN        SUMMAX
  01                4          0.069         0.009         0.220
  05                5          0.037         0.009         0.140
  08                3          0.270         0.009         0.700
  11                4          0.034         0.009         0.100
  15                4          0.022         0.009         0.050
  19                5          0.051         0.009         0.140
  25                4          0.024         0.009         0.049
  27               15          0.245         0.009         1.900
  29                2          0.009         0.009         0.009
  32                2          0.009         0.009         0.009
  33                7          0.168         0.009         0.480
  36                1          0.019         0.019         0.019
  42               42          0.029         0.009         0.310
  44N              56          0.116         0.009         3.200
  44S               2          0.154         0.009         0.300
  46               39          0.042         0.009         0.680
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                          SAS                             9:43 FRIDAY, SEPTEMBER 28, 1984   1
SULPHIDE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                       1981-1982

STATION          SUMN        SUMMEAN        SUMMIN        SUMMAX
  01                4          0.069         0.009         0.220
  05                4          0.044         0.009         0.140
  08                3          0.270         0.009         0.700
  11                4          0.034         0.009         0.100
  15                4          0.022         0.009         0.050
  19                5          0.051         0.009         0.140
  25                4          0.024         0.009         0.049
  27               15          0.245         0.009         1.900
  29                2          0.009         0.009         0.009
  32                2          0.009         0.009         0.009
  33                7          0.168         0.009         0.480
  36                0            .             .             .
  42               17          0.027         0.009         0.310
  44N              17          0.216         0.009         3.200
  44S               2          0.154         0.009         0.300
  46               19          0.060         0.009         0.680
```

APPENDIX 4

SUMMARY OF SEASONAL MEAN VALUES FOR WATER QUALITY VARIABLES AT STATIONS ALONG THE NORTH SASKATCHEWAN RIVER DURING THE PERIODS 1970-1982, AND 1981-1982

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                                    TABLE A4.1  Dissolved Oxygen (mg/L)                     10:57 THURSDAY, SEPTEMBER 27, 1984     1
                    DO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1970-1982

STATION    SN     SMIN    SMAX    SMEAN         FN      FMIN    FMAX   FMEAN         WN     WMIN    WMAX   WMEAN

01         13    5.700  13.000    8.908         11    10.800  15.400  12.800         20    5.300  12.300   9.060
05         14    5.500  12.900    8.957         11     9.800  15.600  13.000         19    3.100  11.200   9.168
08         11    6.400  14.100    8.927         11     9.700  16.300  12.527         13    4.600  12.400   9.054
11          8    5.500  13.400    8.937          5     9.300  16.000  12.780          3    9.800  10.100   9.967
15         23    4.700  10.600    7.813         13     9.600  15.700  12.238         15    4.400  12.000   8.407
19         14    5.300  12.600    7.893          7    10.500  13.000  11.971          3    8.900  10.000   9.300
25         16    5.100  10.500    7.462         10    10.100  14.100  12.390         13    3.700  11.300   8.100
27         34    5.600  13.100    9.179         25     7.800  14.800  11.500         25    3.600  16.100   8.376
29          8    5.000  12.800    8.475          8     9.500  15.200  12.787          7    3.800   9.200   6.929
32          2    2.400   9.300    5.850          3     9.500  13.600  12.100          5    3.600   8.100   5.620
33          2    9.300  10.400    9.850          2     9.700   9.900   9.800          .        .       .       .
36         55    7.000  12.600    9.135         34     3.900  16.400  11.582         48    3.500  15.900   8.279
42         64    3.600  13.700    9.003         34     7.500  18.000  12.079         51    2.400  14.400   7.327
44N        70    3.800  14.500    8.536         38     6.500  14.100  10.826         62    3.400  16.300   7.763
44S        68    2.300  14.000    9.096         36     5.500  16.100  11.994         58    1.600  14.700   7.464
46         47    5.600  12.600    8.883         25     7.300  16.900  12.000         27    1.000  13.900   7.415


                                                   SAS                                8:35 THURSDAY, SEPTEMBER 27, 1984     1
                    DO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1981-1982

STATION    SN     SMIN    SMAX    SMEAN         FN      FMIN    FMAX   FMEAN         WN     WMIN    WMAX   WMEAN

01         10    5.700  13.000    8.620          5    10.900  15.400  13.380          4    5.300  11.000   9.400
05          9    5.500  10.700    8.522          4    11.800  15.600  14.425          4    3.100  10.900   8.300
08          9    6.400  10.900    8.578          5    10.800  16.300  13.160          4    4.600  12.400   9.525
11          8    5.500  13.400    8.937          5     9.300  16.000  12.780          3    9.800  10.100   9.967
15         15    4.700   9.700    6.986          6    10.100  13.100  11.783          4    4.500  11.100   8.850
19         14    5.300  12.600    7.893          7    10.500  13.000  11.971          3    8.900  10.000   9.300
25         14    5.100  10.500    7.214          5    11.200  13.500  12.260          4    5.300  10.700   7.775
27         18    5.600  11.500    8.744         13     7.800  13.400  11.115          7    7.400  12.600   9.029
29          5    5.000   8.500    6.120          3     9.500  13.500  11.933          .        .       .       .
32          2    2.400   9.300    5.650          2     9.500  13.200  11.350          .        .       .       .
33          2    9.300  10.400    9.850          2     9.700   9.900   9.800          .        .       .       .
36          3    8.200  11.600    9.833          4     8.500  14.700  12.550          7    6.600  12.700   9.257
42          4    8.900   9.600    9.150          4     8.000  14.900  12.725          6    7.000  14.100  10.433
44N         4    6.300   8.500    7.500          5     8.000  13.600  11.360          7    5.700  10.100   8.500
44S         4    5.800   9.700    8.450          4     8.900  14.900  12.500          7    6.200   9.800   8.314
46          7    5.600  11.900    8.986          6     9.700  14.500  12.367          5    8.800  11.300   9.920
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TABLE A4.2 Oxygen Saturation (%)

8:08 FRIDAY, SEPTEMBER 28, 1984

SAT SUMMARY GOING DOWNSTREAM OF THE R.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	12	66.300	144	102.96	10	100	124	109	19	7.300	90.800	65.195
05	12	64.300	120	98.400	10	89.000	118	107.8	19	22.500	81.500	67.653
08	9	74.300	119	96.944	10	91.000	120	104.5	11	34.800	91.000	66.127
11	8	64.000	158	102.88	5	90.000	118	100.2	3	72.000	74.000	73.000
15	23	55.000	119	87.991	12	88.100	122	101.66	13	32.000	99.200	60.746
19	14	60.900	148	92.043	7	77.700	117	99.457	3	64.000	72.000	67.000
25	15	54.500	124	84.840	9	84.400	123	102.89	12	27.000	81.600	59.183
27	36	67.000	148	101.14	23	63.000	122	95.043	27	26.000	116.2	61.315
29	7	56.300	116	78.700	8	95.000	140	110.5	7	28.000	67.000	50.571
32	2	27.300	108	67.500	3	92.000	112	100.67	4	26.000	52.000	36.750
33	2	93.300	108	100.5	2	80.000	98.000	89.000	.	.	.	.
36	55	52.000	137	97.885	31	37.900	120	96.787	48	25.000	116	61.444
42	65	26.300	156	94.414	32	80.600	129	101.33	50	17.000	112	53.576
44N	71	28.300	147	90.318	36	61.000	109	91.806	62	25.000	114	57.289
44S	68	17.300	153	96.096	34	8.000	117	97.821	57	12.000	113	54.149
46	48	54.000	136	96.548	24	78.100	126.1	100.8	26	7.000	110	54.058

9:24 FRIDAY, SEPTEMBER 28, 1984 41

SAS
SAT SUMMARY GOING DOWNSTREAM OF THE R.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	10	66.300	144	120.05	4	104	114	108.75	4	7.300	81.000	61.325
05	9	64.000	119	96.867	4	109	118	114.75	4	22.500	80.000	63.625
08	9	74.300	119	96.944	5	97.000	120	104.4	4	34.800	91.000	69.950
11	8	64.000	158	102.88	5	90.000	118	100.2	3	72.000	74.000	73.000
15	14	55.300	114	79.914	6	88.100	107	97.817	4	32.500	80.000	63.875
19	14	60.900	148	92.043	7	77.700	117	99.457	3	64.000	72.000	67.000
25	14	54.500	124	83.543	5	84.400	110	98.000	4	38.000	78.000	56.150
27	18	67.000	132	99.683	13	63.000	122	91.577	8	53.200	92.000	64.912
29	5	56.300	98.000	67.180	3	95.000	140	115.33	.	.	.	.
32	2	27.300	108	67.500	2	92.000	112	102	.	.	.	.
33	2	93.000	108	100.5	2	80.000	98.000	89.000	.	.	.	.
36	3	90.700	127.5	103.73	4	87.000	110	99.750	7	47.000	90.000	67.700
42	4	70.000	114	91.750	4	83.000	118	101	6	50.000	102	75.800
44N	4	75.300	93.000	82.975	5	85.000	99.000	91.400	7	41.000	73.000	61.429
44S	4	67.000	113	89.950	4	94.000	108	101.25	7	44.600	72.000	60.314
46	7	65.000	113	92.100	6	94.000	110	103.17	5	64.000	81.000	71.620

TABLE A4.3 Water Temperature (°C) 13:37 FRIDAY, JULY 20, 1984 3

TEMP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	21	12.000	22.000	19.048	14	0.000	18.000	7.429	28	0.000	3.000	0.375
05	21	13.000	26.000	19.167	16	0.000	18.000	7.125	18	0.000	4.000	0.472
08	13	13.000	22.000	18.346	14	0.000	19.000	7.500	12	0.000	2.500	0.542
11	14	18.500	22.000	20.321	7	0.000	13.000	6.071	3	0.000	0.000	0.000
15	27	12.000	23.000	19.333	17	0.000	17.000	7.882	15	0.000	5.000	0.547
19	23	19.000	22.500	20.696	7	1.000	12.000	5.143	3	0.000	0.000	0.000
25	20	11.000	24.000	20.875	12	0.000	16.000	6.542	13	0.000	2.500	0.554
27	36	11.000	24.000	18.903	29	0.000	17.000	6.879	26	0.000	3.000	0.277
29	8	2.500	20.000	13.250	13	0.000	16.500	8.500	8	0.000	0.500	0.313
32	2	19.000	20.000	19.500	5	0.000	12.000	8.400	5	0.000	2.000	0.500
33	2	8.000	20.000	14.000	4	5.000	13.000	11.000	.	.	.	.
36	57	0.000	26.000	16.342	34	0.000	15.000	6.794	51	0.000	6.000	0.014
42	68	0.000	29.500	15.684	35	0.000	17.000	6.671	51	0.000	3.500	0.480
44N	72	0.000	25.000	16.035	39	0.000	55.000	8.115	64	0.000	5.000	0.766
44S	68	0.000	24.500	16.221	38	0.000	17.000	6.632	61	0.000	3.500	0.500
46	48	0.000	24.000	18.021	29	0.000	14.500	7.155	26	0.000	3.500	0.462

SAS 10:46 FRIDAY, JULY 20, 1984 3

TEMP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	17	15.000	22.000	19.824	7	0.000	14.000	7.000	4	0.000	0.000	0.000
05	16	16.000	26.000	20.000	7	0.000	13.000	6.857	4	0.000	0.000	0.000
08	10	16.000	22.000	19.300	7	0.000	14.000	6.571	4	0.000	0.000	0.000
11	14	18.500	22.000	20.321	7	0.000	13.000	6.071	3	0.000	0.000	0.000
15	18	17.000	23.000	20.556	8	1.000	16.000	7.688	4	0.000	0.000	0.000
19	23	19.000	22.500	20.696	7	1.000	12.000	5.143	3	0.000	0.000	0.000
25	18	11.000	24.000	20.417	7	1.000	13.000	6.429	4	0.000	0.000	0.000
27	21	13.000	24.000	20.071	16	0.000	14.000	6.313	7	0.000	0.500	0.071
29	5	11.000	20.000	17.600	5	7.000	15.000	12.200	.	.	.	.
32	2	19.000	20.000	19.500	4	6.000	12.000	10.500	.	.	.	.
33	2	8.000	20.000	14.000	4	5.000	13.000	11.000	.	.	.	.
36	4	10.500	21.000	17.250	4	0.000	14.000	4.500	7	0.000	3.000	1.000
42	8	7.000	21.500	13.375	4	0.000	15.000	4.750	6	0.000	2.000	0.417
44N	7	8.000	22.000	16.429	6	0.000	16.000	6.250	7	0.000	4.000	0.857
44S	6	12.000	21.000	17.333	5	0.000	16.000	6.900	7	0.000	0.500	0.143
46	8	8.000	21.000	16.188	8	1.000	16.000	8.000	5	0.000	0.500	0.200

TABLE A4.4 Total Organic Carbon (mg/L)

10:57 THURSDAY, SEPTEMBER 27, 1984 2

TOC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	23	0.000	13.000	8.039	20	0.900	15.000	7.295	16	0.900	14.000	6.362
05	20	0.000	23.000	9.250	15	2.000	16.000	7.867	18	0.900	17.500	7.144
08	15	0.000	13.000	5.933	12	1.000	14.000	8.667	13	0.900	12.000	4.323
11	15	0.000	14.000	8.533	6	2.000	15.000	8.167	3	0.900	0.900	0.900
15	26	0.000	18.000	7.604	16	1.000	18.000	8.625	11	1.000	14.000	5.091
19	23	0.000	11.000	6.174	5	3.000	15.000	9.600	3	0.900	7.000	2.933
25	19	0.000	14.000	6.000	13	2.000	27.000	9.846	12	0.900	15.500	5.517
27	35	0.000	24.000	7.194	41	1.000	16.000	8.244	19	0.000	18.000	5.247
29	8	0.900	15.000	7.362	13	4.000	14.000	9.000	6	0.900	4.000	2.283
32	4	2.000	6.000	3.750	6	7.000	10.000	8.833	2	0.900	2.000	1.450
33	9	0.900	15.000	6.989	6	6.000	10.000	7.333	.	.	.	.
36	42	2.000	48.000	12.274	23	2.000	15.000	7.957	36	0.900	35.000	6.358
42	43	0.000	45.000	13.155	18	2.000	22.000	8.667	25	0.500	17.000	6.236
44N	45	0.900	45.000	16.664	24	6.000	25.000	13.458	40	0.500	35.000	14.537
44S	42	0.000	50.000	12.190	23	1.000	22.000	9.043	41	0.000	19.000	6.020
46	39	0.900	23.000	11.562	22	3.000	20.000	8.682	21	1.000	19.000	7.143

SAS

8:35 THURSDAY, SEPTEMBER 27, 1984 2

TOC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	19	0.000	13.000	7.311	14	3.000	15.000	7.000	4	0.900	7.000	3.450
05	15	0.000	14.000	7.867	6	2.000	16.000	10.000	4	0.900	7.000	2.425
08	12	0.000	13.000	5.167	6	1.000	14.000	8.000	4	0.900	7.000	2.425
11	15	0.000	14.000	8.533	6	2.000	15.000	8.167	3	0.900	0.900	0.900
15	19	0.000	10.000	6.621	7	1.000	18.000	10.286	5	1.000	8.000	4.200
19	23	0.000	11.000	6.174	5	3.000	15.000	9.600	3	0.900	7.000	2.933
25	17	0.000	10.000	5.235	7	2.000	16.000	8.143	4	0.900	6.000	3.450
27	20	0.000	24.000	6.295	27	1.000	16.000	8.481	7	0.900	15.000	5.400
29	7	0.900	15.000	6.986	7	7.000	10.000	8.571	.	.	.	.
32	4	2.000	6.000	3.750	6	7.000	10.000	8.833	.	.	.	.
33	9	0.900	15.000	6.989	6	6.000	10.000	7.333	.	.	.	.
36	4	4.000	25.000	13.750	3	6.000	12.000	8.667	5	2.000	18.000	8.000
42	8	3.000	15.000	10.500	3	6.000	18.000	11.667	4	2.000	9.000	4.000
44N	7	0.900	40.000	13.271	5	8.000	19.000	11.400	5	3.000	30.000	11.800
44S	7	2.000	16.000	8.857	5	5.000	22.000	11.600	5	1.000	10.000	3.800
46	10	0.900	19.000	7.090	9	6.000	9.000	7.556	4	3.000	12.000	6.000

TABLE A4.5 Biochemical Oxygen Demand (mg/L)

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                                                                                        10:57 THURSDAY, SEPTEMBER 27, 1984   12
                  BOD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1970-1982

STATION      SN      SMIN    SMAX    SMEAN            FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01           26     0.600   6.500   2.458            27     0.400   8.000   2.593          21     0.200   3.000   1.514
05           22     0.600   5.500   2.500            21     0.400   6.500   2.240          20     0.300   2.800   1.515
08           13     1.000   4.800   2.323            17     0.600   5.500   2.353          15     0.400   3.300   1.420
11           18     0.600   4.600   2.267             9     0.600   3.800   1.933           3     0.600   1.000   0.733
15           30     1.000   5.000   2.777            21     0.600  40.000   3.857          17     0.200   5.000   1.176
19           25     0.800   5.000   3.072             7     0.600   2.800   1.600           3     0.800   0.800   0.800
25           20     0.600   4.800   2.760            16     0.600   3.700   1.900          13     0.400   3.800   1.246
27           39     0.600   5.000   2.723            44     0.600   7.000   2.595          28     0.400  12.000   1.625
29            9     1.700   4.400   3.056            14     1.000   6.500   3.286          10     0.300  13.000   2.560
32            4     1.600   3.600   2.950             7     1.500   4.400   3.614           5     0.400   1.000   0.740
33            6     3.000   4.200   3.767             6     2.600   4.000   3.033           .       .       .       .
36           64     0.500  31.000   3.617            38     0.200   7.000   2.784          49     0.500  40.000   2.798
42           63     0.600  15.000   3.095            35     0.100   6.500   2.597          47     0.300  13.000   1.700
44N          66     0.600  35.000   5.161            32     2.200  35.000   6.956          53     1.200  42.000   6.838
44S          69     0.500   8.000   3.017            38     0.400  13.500   3.611          63     0.000  10.000   2.067
46           52     0.800   7.000   2.871            30     0.600   7.000   2.537          29     0.400   5.500   2.190


                                             SAS                                        8:35 THURSDAY, SEPTEMBER 27, 1984   12
                  BOD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1981-1982

STATION      SN      SMIN    SMAX    SMEAN            FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01           20     0.800   4.200   2.270            18     0.800   8.000   2.956           4     0.600   1.200   0.950
05           17     1.000   3.800   2.494             9     0.800   4.400   2.200           4     0.600   1.400   0.850
08           12     1.000   4.800   2.250             8     0.600   4.600   2.250           4     0.600   1.400   0.950
11           18     0.600   4.600   2.267             9     0.600   3.800   1.933           3     0.600   1.000   0.733
15           20     1.000   4.400   2.680            10     0.600   3.000   1.700           5     0.600   1.000   0.880
19           25     0.800   5.000   3.072             7     0.600   2.800   1.600           3     0.800   0.800   0.800
25           18     1.400   4.000   2.767             8     0.600   2.800   1.725           3     0.600   0.800   0.733
27           21     1.200   5.000   2.705            30     0.600   5.000   2.590           8     0.600  12.000   2.200
29            7     2.200   4.400   3.200             6     2.800   4.600   3.867           .       .       .       .
32            4     1.600   3.600   2.950             6     3.600   4.400   3.967           .       .       .       .
33            6     3.000   4.200   3.767             6     2.600   4.000   3.033           .       .       .       .
36            7     1.400   4.600   2.629             4     0.200   1.200   0.900           7     0.600  22.000   5.014
42            2     2.600   4.000   3.300             4     0.100   1.400   0.975           6     0.600   2.600   0.933
44N           5     1.000   4.800   2.960             3     2.200   3.400   2.867           4     1.200   4.600   2.350
44S           6     1.600   5.000   2.900             6     0.400   4.600   1.800           7     0.000   1.600   1.030
46            9     1.800   4.200   2.978            10     0.600   3.800   2.120           4     0.400   3.800   1.650
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TABLE A4.6 Total Kjeldahl Nitrogen (mg/L)

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                                                                                    10:57 THURSDAY, SEPTEMBER 27, 1984     3
                   TKN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION     SN      SMIN    SMAX    SMEAN         FN     FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01          26      0.400   1.900   0.765         23     0.200   2.100   0.822          20      0.600   7.800   1.360
05          24      0.400   2.200   0.671         18     0.100   1.600   0.839          19      0.400   2.400   0.821
08          15      0.400   2.000   0.919         14     0.200   1.800   0.686          14      0.500   2.400   0.871
11          18      0.200   3.300   0.828          6     0.100   0.800   0.417           3      0.600   0.600   0.600
15          30      0.600   3.500   1.057         18     0.100  39.000   2.933          15      0.400   2.700   0.928
19          25      0.500   1.400   0.940          5     0.100   0.800   0.360           3      0.600   0.700   0.667
25          20      0.500   1.600   0.900         14     0.200   1.600   0.693          13      0.400   2.400   0.946
27          40      0.300   3.700   0.902         45     0.100   2.400   0.687          24      0.300   2.300   0.812
29          10      0.800   2.500   1.370         15     0.300   1.800   0.948           9      0.500   2.400   1.190
32           4      0.700   1.100   0.875          7     0.600   1.620   0.803           4      0.400   1.840   1.320
33           9      0.900   1.800   1.322          6     0.400   0.900   0.600           .        .       .       .
36          61      0.300   3.600   1.201         35     0.100   3.300   0.882          51      0.200  17.000   1.347
42          60      0.300   3.800   1.388         31     0.300   3.000   0.973          39      0.200   2.700   0.938
44N         64      0.290   5.700   1.463         37     0.160   3.000   1.051          55      0.300   5.500   1.386
44S         61      0.300   3.700   1.212         38     0.200   3.000   0.918          57      0.200   2.400   1.035
46          51      0.290  11.400   1.345         30     0.200   1.200   0.696          26      0.300   2.100   0.877


                                                       SAS                         8:35 THURSDAY, SEPTEMBER 27, 1984     3
                   TKN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION     SN      SMIN    SMAX    SMEAN         FN     FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01          20      0.400   1.900   0.745         14     0.400   1.400   0.764           4      0.600   0.800   0.675
05          18      0.400   1.600   0.783          6     0.200   1.000   0.500           4      0.600   0.700   0.625
08          12      0.400   2.000   0.900          6     0.200   0.700   0.450           4      0.600   0.700   0.675
11          18      0.200   3.300   0.828          6     0.100   0.800   0.417           3      0.600   0.600   0.600
15          20      0.600   1.600   0.935          7     0.100   0.800   0.457           5      0.400   0.800   0.620
19          25      0.500   1.400   0.940          5     0.100   0.800   0.360           3      0.600   0.700   0.667
25          18      0.500   1.600   0.900          7     0.200   1.100   0.529           4      0.600   0.700   0.625
27          22      0.300   1.800   0.786         28     0.100   1.900   0.575           8      0.300   2.300   0.812
29           7      0.800   1.800   1.157          7     0.600   1.300   0.814           .        .       .       .
32           4      0.700   1.100   0.875          6     0.600   0.800   0.667           .        .       .       .
33           9      0.900   1.800   1.322          6     0.400   0.900   0.600           .        .       .       .
36           5      0.700   1.000   0.600          4     0.300   0.500   0.350           7      0.200  17.000   3.357
42           8      0.700   3.000   1.400          4     0.300   0.500   0.400           6      0.200   2.700   0.800
44N          8      0.700   2.100   1.087          6     0.300   0.900   0.550           7      0.400   1.700   0.843
44S          8      0.600   3.400   1.212          6     0.200   1.100   0.617           7      0.300   1.700   0.714
46          12      0.600   2.200   1.242         10     0.200   1.000   0.590           5      0.400   1.100   0.680
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TABLE A4.7 Nitrate - Nitrogen (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

NO3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	26	0.029	0.610	0.238	27	0.019	0.440	0.130	26	0.200	0.660	0.469
05	24	0.019	0.640	0.234	20	0.019	0.630	0.228	19	0.320	0.540	0.421
08	15	0.029	0.440	0.224	18	0.009	0.540	0.200	14	0.310	0.710	0.456
11	18	0.029	0.440	0.119	9	0.029	0.240	0.111	3	0.340	0.570	0.463
15	31	0.009	0.880	0.238	22	0.019	0.630	0.164	15	0.340	1.010	0.515
19	25	0.029	0.950	0.234	7	0.029	0.270	0.124	3	0.340	1.220	0.643
25	20	0.029	0.700	0.141	18	0.019	0.630	0.140	13	0.340	0.680	0.465
27	40	0.019	1.830	0.179	47	0.019	0.680	0.143	24	0.380	5.240	0.767
29	10	0.029	0.440	0.259	15	0.019	0.520	0.119	9	0.230	0.900	0.573
32	4	0.100	0.570	0.237	7	0.029	0.590	0.109	4	0.410	0.900	0.672
33	9	0.100	1.120	0.628	6	0.029	0.029	0.029	.	.	.	.
36	63	0.019	1.100	0.193	40	0.019	0.500	0.140	53	0.030	1.200	0.537
42	64	0.019	2.100	0.297	36	0.019	0.500	0.112	38	0.160	3.160	0.598
44N	67	0.019	17.300	0.495	42	0.019	1.010	0.119	54	0.180	0.900	0.494
44S	64	0.019	1.300	0.232	42	0.009	0.500	0.120	56	0.030	0.900	0.531
46	54	0.019	0.960	0.227	33	0.019	0.410	0.101	26	0.300	0.860	0.556

9:24 FRIDAY, SEPTEMBER 28, 1984

SAS
NO3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	20	0.029	0.610	0.250	18	0.029	0.270	0.113	4	0.340	0.610	0.475
05	18	0.029	0.640	0.242	8	0.029	0.240	0.161	4	0.340	0.540	0.440
08	12	0.029	0.440	0.221	9	0.029	0.240	0.139	4	0.410	0.710	0.492
11	18	0.029	0.440	0.119	9	0.029	0.240	0.111	3	0.340	0.570	0.483
15	20	0.029	0.680	0.316	10	0.029	0.270	0.101	5	0.340	1.010	0.568
19	25	0.029	0.950	0.234	7	0.029	0.270	0.124	3	0.340	1.220	0.643
25	18	0.029	0.700	0.151	10	0.029	0.240	0.136	4	0.470	0.680	0.532
27	22	0.029	1.830	0.197	30	0.029	0.680	0.138	8	0.440	5.240	1.242
29	7	0.029	0.440	0.234	7	0.029	0.029	0.029	.	.	.	.
32	4	0.100	0.570	0.237	6	0.029	0.029	0.029	.	.	.	.
33	9	0.100	1.120	0.628	6	0.029	0.029	0.029	.	.	.	.
36	5	0.029	0.440	0.154	4	0.029	0.340	0.185	7	0.410	0.810	0.574
42	9	0.029	1.050	0.611	4	0.029	0.300	0.167	6	0.470	0.880	0.563
44N	8	0.030	1.150	0.447	6	0.029	1.210	0.251	7	0.410	0.810	0.566
44S	8	0.029	1.010	0.437	6	0.029	0.270	0.140	7	0.410	0.880	0.546
46	12	0.029	0.980	0.456	10	0.029	0.370	0.101	5	0.410	0.850	0.590

TABLE A4.8 Ammonia - Nitrogen (mg/L)

NH3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	HN	HMIN	HMAX	HMEAN
01	26	0.009	0.670	0.077	23	0.010	0.450	0.107	21	0.070	1.170	0.609
05	24	0.009	0.660	0.055	18	0.009	1.100	0.220	20	0.050	0.990	0.442
08	15	0.009	0.590	0.079	15	0.009	1.050	0.166	15	0.030	1.170	0.409
11	18	0.009	0.140	0.039	6	0.010	0.190	0.085	3	0.320	0.720	0.460
15	29	0.009	0.580	0.077	19	0.010	30.800	1.772	17	0.040	0.920	0.459
19	23	0.009	0.080	0.025	5	0.010	0.200	0.088	3	0.330	0.350	0.340
25	18	0.009	0.130	0.038	15	0.009	0.390	0.088	14	0.070	0.820	0.414
27	40	0.009	0.700	0.083	45	0.009	0.800	0.062	28	0.040	1.150	0.416
29	10	0.010	0.570	0.142	15	0.010	0.840	0.127	10	0.200	0.770	0.550
32	4	0.010	0.030	0.017	7	0.010	0.650	0.123	5	0.190	0.920	0.690
33	9	0.010	0.240	0.087	6	0.009	0.060	0.028	.	.	.	.
36	64	0.009	0.940	0.257	41	0.009	0.710	0.163	53	0.009	20.500	0.955
42	71	0.009	0.960	0.262	37	0.009	0.690	0.171	48	0.009	2.200	0.620
44N	76	0.009	0.940	0.302	43	0.009	0.820	0.262	63	0.009	1.580	0.579
44S	74	0.009	1.000	0.281	42	0.009	0.750	0.196	64	0.010	1.570	0.586
46	58	0.009	0.920	0.187	33	0.009	0.560	0.115	30	0.009	0.990	0.476

NH3N SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	HN	HMIN	HMAX	HMEAN
01	20	0.009	0.140	0.032	14	0.010	0.220	0.074	4	0.070	0.450	0.322
05	18	0.009	0.090	0.028	6	0.010	0.210	0.113	4	0.050	0.360	0.262
08	12	0.009	0.100	0.044	6	0.010	0.200	0.093	4	0.030	0.380	0.257
11	18	0.009	0.140	0.039	6	0.010	0.190	0.085	3	0.320	0.720	0.460
15	18	0.009	0.040	0.019	7	0.010	0.130	0.070	5	0.040	0.360	0.226
19	23	0.009	0.080	0.025	5	0.010	0.200	0.088	3	0.330	0.350	0.340
25	16	0.009	0.130	0.038	7	0.009	0.100	0.070	4	0.070	0.450	0.295
27	20	0.009	0.080	0.028	28	0.009	0.170	0.036	8	0.040	0.380	0.230
29	7	0.010	0.070	0.034	7	0.010	0.220	0.061	.	.	.	.
32	4	0.010	0.030	0.017	6	0.010	0.060	0.035	.	.	.	.
33	9	0.010	0.240	0.087	6	0.009	0.060	0.028	.	.	.	.
36	5	0.009	0.040	0.022	4	0.009	0.090	0.045	7	0.009	6.200	1.104
42	9	0.020	0.320	0.121	4	0.009	0.100	0.042	6	0.009	0.330	0.203
44N	8	0.009	0.380	0.089	6	0.020	0.110	0.062	7	0.030	0.340	0.176
44S	8	0.009	0.320	0.066	6	0.009	0.250	0.076	7	0.010	0.350	0.207
46	12	0.009	0.199	0.052	10	0.009	0.060	0.032	5	0.009	0.320	0.160

TABLE A4.9 Total Phosphorus (mg/L)

10:57 THURSDAY, SEPTEMBER 27, 1984 5

TP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	26	0.009	0.850	0.200	26	0.010	0.800	0.113	21	0.030	0.220	0.091
05	24	0.020	0.800	0.215	21	0.009	0.160	0.078	20	0.030	0.360	0.116
08	15	0.030	1.200	0.275	18	0.009	0.150	0.077	15	0.030	0.300	0.138
11	18	0.070	1.800	0.232	9	0.070	0.150	0.092	3	0.150	0.230	0.190
15	31	0.010	0.550	0.228	22	0.010	10.600	0.555	17	0.030	0.200	0.094
19	25	0.120	14.100	0.824	7	0.060	0.210	0.101	3	0.130	0.230	0.163
25	20	0.020	1.200	0.291	18	0.020	0.230	0.096	14	0.020	0.510	0.137
27	42	0.020	1.900	0.183	47	0.010	0.600	0.114	27	0.030	0.430	0.113
29	10	0.040	0.600	0.222	15	0.010	0.300	0.089	10	0.020	0.220	0.090
32	4	0.120	0.190	0.137	7	0.020	0.130	0.086	5	0.060	0.100	0.078
33	9	0.120	0.550	0.264	6	0.060	0.220	0.110	.	.	.	.
36	63	0.020	0.460	0.107	41	0.009	0.460	0.067	53	0.009	2.600	0.119
42	71	0.009	0.620	0.140	37	0.000	0.240	0.066	49	0.009	0.170	0.075
44N	75	0.010	0.500	0.122	43	0.009	0.320	0.069	63	0.010	0.300	0.091
44S	72	0.020	0.700	0.126	43	0.009	0.270	0.069	64	0.009	0.390	0.088
46	57	0.020	0.610	0.146	33	0.000	0.330	0.069	30	0.010	0.220	0.078

8:35 THURSDAY, SEPTEMBER 27, 1984 5

SAS

TP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	20	0.060	0.850	0.213	17	0.070	0.800	0.141	4	0.120	0.220	0.170
05	18	0.070	0.800	0.246	9	0.050	0.130	0.091	4	0.120	0.360	0.215
08	12	0.070	1.200	0.279	9	0.070	0.110	0.089	4	0.230	0.300	0.252
11	18	0.070	1.800	0.232	9	0.070	0.150	0.092	3	0.150	0.230	0.190
15	20	0.120	0.550	0.296	10	0.070	0.210	0.105	5	0.130	0.200	0.150
19	25	0.120	14.100	0.824	7	0.060	0.210	0.101	3	0.130	0.230	0.163
25	18	0.110	1.200	0.306	10	0.080	0.230	0.129	4	0.130	0.510	0.230
27	22	0.080	0.550	0.151	30	0.040	0.600	0.128	8	0.070	0.430	0.171
29	7	0.090	0.600	0.297	7	0.040	0.300	0.134	.	.	.	.
32	4	0.120	0.190	0.137	6	0.060	0.130	0.097	.	.	.	.
33	9	0.120	0.550	0.264	6	0.060	0.220	0.110	.	.	.	.
36	5	0.100	0.330	0.170	4	0.040	0.100	0.070	7	0.070	2.600	0.491
42	9	0.140	0.620	0.324	4	0.060	0.100	0.077	6	0.080	0.170	0.138
44N	7	0.130	0.280	0.206	6	0.060	0.110	0.078	7	0.090	0.200	0.131
44S	8	0.100	0.700	0.304	6	0.060	0.120	0.083	7	0.070	0.150	0.121
46	12	0.110	0.610	0.293	10	0.060	0.200	0.095	5	0.080	0.220	0.116

TABLE A4.10 Ortho Phosphorus (mg/L)

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                                                                                   10:57 THURSDAY, SEPTEMBER 27, 1984     6
                OP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1970-1982

STATION    SN     SMIN   SMAX   SMEAN        FN    FMIN   FMAX   FMEAN        HN    HMIN   HMAX   HMEAN

01         26    0.009  0.110  0.039        27   0.009  0.700  0.076        18   0.009  0.150  0.072
05         23    0.009  0.210  0.047        21   0.009  0.140  0.042        17   0.020  0.220  0.076
08         15    0.009  0.080  0.038        18   0.009  0.090  0.040        13   0.029  0.250  0.110
11         18    0.009  0.060  0.025         9   0.010  0.120  0.048         3   0.150  0.220  0.187
15         29    0.000  0.060  0.029        22   0.009  5.400  0.277        14   0.010  0.150  0.074
19         23    0.010  0.060  0.028         7   0.020  0.150  0.049         3   0.120  0.190  0.143
25         18    0.010  0.150  0.033        18   0.009  0.120  0.034        11   0.009  0.240  0.092
27         40    0.009  0.100  0.028        47   0.000  0.180  0.032        25   0.020  0.180  0.081
29         10    0.010  0.060  0.032        15   0.009  0.060  0.022         7   0.009  0.090  0.061
32          4    0.010  0.050  0.022         7   0.009  0.040  0.020         5   0.030  0.100  0.060
33          9    0.010  0.060  0.036         6   0.009  0.040  0.021         .       .      .      .
36         63    0.009  0.200  0.028        40   0.000  0.150  0.017        53   0.007  1.750  0.096
42         71    0.000  0.200  0.030        37   0.000  0.040  0.014        47   0.007  0.150  0.051
44N        76    0.000  0.380  0.036        43   0.000  0.050  0.016        63   0.003  0.130  0.048
44S        73    0.000  0.080  0.027        42   0.000  0.060  0.014        63   0.009  0.140  0.054
46         58    0.009  0.099  0.027        33   0.000  0.050  0.018        30   0.009  0.140  0.050


                                         SAS                                8:35 THURSDAY, SEPTEMBER 27, 1984     6
                OP SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                     1981-1982

STATION    SN     SMIN   SMAX   SMEAN        FN    FMIN   FMAX   FMEAN        HN    HMIN   HMAX   HMEAN

01         20    0.009  0.110  0.043        18   0.020  0.700  0.100         4   0.130  0.150  0.135
05         18    0.009  0.210  0.045         9   0.010  0.090  0.058         4   0.130  0.220  0.165
08         12    0.009  0.080  0.041         9   0.010  0.080  0.048         4   0.150  0.250  0.205
11         18    0.009  0.060  0.025         9   0.010  0.120  0.048         3   0.150  0.220  0.197
15         18    0.010  0.060  0.031        10   0.020  0.140  0.052         5   0.100  0.150  0.118
19         23    0.010  0.060  0.028         7   0.020  0.150  0.049         3   0.120  0.190  0.143
25         16    0.010  0.150  0.034        10   0.030  0.120  0.047         4   0.100  0.240  0.145
27         20    0.010  0.060  0.028        30   0.009  0.100  0.036         8   0.060  0.170  0.110
29          7    0.010  0.060  0.036         7   0.009  0.040  0.022         .       .      .      .
32          4    0.010  0.050  0.022         6   0.009  0.040  0.021         .       .      .      .
33          9    0.010  0.060  0.036         6   0.009  0.040  0.021         .       .      .      .
36          5    0.010  0.080  0.036         4   0.010  0.050  0.027         7   0.060  0.900  0.216
42          9    0.010  0.120  0.063         4   0.010  0.030  0.022         6   0.080  0.150  0.103
44N         8    0.020  0.380  0.089         6   0.009  0.040  0.028         7   0.010  0.130  0.070
44S         8    0.010  0.060  0.042         6   0.010  0.050  0.027         7   0.070  0.140  0.096
46         12    0.010  0.099  0.042        10   0.009  0.050  0.025         5   0.060  0.140  0.092
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TABLE A4.11 pH

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                                                SAS                                           13:37 FRIDAY, JULY 20, 1984   2
                       PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1970-1982

STATION      SN      SMIN    SMAX    SMEAN            FN      FMIN    FMAX    FMEAN            WN      WMIN    WMAX    WMEAN

01           26     7.300   9.000   8.381             27     7.900   9.900   8.522            21     7.400   8.300   7.776
05           23     7.900   8.900   8.400             21     7.800   9.100   8.362            20     7.500   8.100   7.765
08           15     7.900   9.000   8.367             18     7.800   9.000   8.383            15     7.500   8.100   7.760
11           18     8.000   9.100   8.567              9     7.900   8.700   8.356             3     7.300   7.600   7.467
15           31     7.500   8.900   8.297             22     7.700   8.700   8.319            17     7.400   8.200   7.735
19           25     7.500   8.900   8.480              7     7.800   8.600   8.229             3     7.600   7.900   7.733
25           20     7.700   8.700   8.405             18     7.800   8.600   8.333            14     7.600   8.200   7.779
27           42     7.000   9.000   8.345             47     6.900   8.800   8.253            28     6.900   8.100   7.636
29           10     7.500   8.600   8.040             15     8.200   8.700   8.427            10     7.300   8.000   7.690
32            4     7.400   8.600   8.275              7     8.300   8.600   8.457             5     7.400   8.100   7.680
33            9     7.200   8.600   7.711              6     8.300   8.600   8.433             .         .       .       .
36           65     7.100   9.100   8.246             42     7.500   9.000   8.238            54     6.900   8.900   7.806
42           72     5.400   9.200   8.065             35     7.100   8.900   8.231            49     6.800   8.400   7.667
44N          77     6.700   8.800   7.945             42     7.500   8.800   8.102            64     6.900   8.300   7.666
44S          74     7.000   9.000   8.069             42     7.600   9.000   8.314            65     6.200   8.500   7.735
46           58     7.200   9.200   8.112             32     7.500   8.700   8.244            30     7.100   8.900   7.740

                                                SAS                                           10:46 FRIDAY, JULY 20, 1984   2
                       PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                          1981-1982

STATION      SN      SMIN    SMAX    SMEAN            FN      FMIN    FMAX    FMEAN            WN      WMIN    WMAX    WMEAN

01           20     7.700   9.000   8.440             18     7.900   8.800   8.556             4     7.400   7.900   7.700
05           18     7.900   8.900   8.456              9     7.800   9.100   8.456             4     7.500   7.600   7.575
08           12     7.900   9.000   8.409              9     7.800   9.000   8.400             4     7.500   7.600   7.550
11           18     8.000   9.100   8.567              9     7.900   8.700   8.356             3     7.300   7.600   7.467
15           20     7.500   8.900   8.370             10     7.700   8.600   8.350             5     7.400   7.900   7.600
19           25     7.500   8.900   8.480              7     7.800   8.600   8.229             3     7.600   7.900   7.733
25           18     7.700   8.700   8.428             10     7.800   8.600   8.330             4     7.600   7.700   7.675
27           22     7.000   9.000   8.341             30     7.700   8.800   8.290             8     7.200   7.800   7.550
29            7     7.500   8.600   8.129              7     8.200   8.700   8.500             .         .       .       .
32            4     7.400   8.600   8.275              6     8.400   8.600   8.483             .         .       .       .
33            9     7.200   8.600   7.911              6     8.300   8.600   8.433             .         .       .       .
36            5     7.100   8.800   8.200              4     7.900   8.300   8.200             7     7.600   7.800   7.714
42            9     7.500   8.600   7.889              4     8.200   8.400   8.275             6     7.500   7.900   7.717
44N           8     7.200   8.600   7.850              6     7.900   8.700   8.217             7     7.400   8.200   7.714
44S           8     7.000   8.800   7.962              6     8.000   8.400   8.250             7     7.500   7.900   7.743
46           12     7.200   8.500   8.008             10     7.900   8.600   8.300             5     7.700   7.900   7.760
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TABLE A4.12 Total Alkalinity (mg/L)

TALK SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1973-1982

8:08 FRIDAY, SEPTEMBER 28, 1984

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	25	104	164	127	27	131	164	145.22	21	120	170	142.81
05	23	100	152	124.39	21	126	206	147.95	20	116	171	135.6
08	14	106	140	127.57	18	134	200	146.61	15	114	171	143.33
11	18	90.000	150	130.17	9	130	142	136.11	3	144	162	150.67
15	31	120	210	137.06	22	126	449	173.73	17	116	331	160.82
19	25	124	158	135.36	7	135	150	142.71	3	54.000	157	122.33
25	20	126	148	136.05	18	138	206	154.39	14	118	188	152.86
27	41	118	166	131.2	47	120	214	151.72	28	100	198	158.29
29	10	116	146	127	15	132	212	158.87	10	134	184	156.6
32	4	122	131	128.5	7	142	208	155.14	5	136	188	163.6
33	9	102	134	123.33	6	142	150	146.17	.	.	.	.
36	64	110	266	145.2	40	108	210	153.45	54	134	299	173.41
42	71	25.000	226	145.9	37	96.000	289	165.65	49	136	260	182.61
44N	74	76.000	450	152.66	43	100	222	160.7	64	130	258	177.27
44S	73	10.000	378	140.1	42	104	218	156.36	65	46.000	267	172.8
46	57	105	180	141.46	33	110	212	154.21	30	146	214	172.5

TALK SUMMARY GOING DOWNSTREAM OF THE SAS N.SASK.RIVER
1981-1982

9:24 FRIDAY, SEPTEMBER 28, 1984

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	20	104	140	123.85	18	131	152	143.56	4	146	168	155
05	18	100	137	121.44	9	131	148	139.56	4	140	162	147.5
08	12	106	140	128	9	134	141	137.33	4	144	160	150
11	18	90.000	150	130.17	9	130	142	136.11	3	144	162	150.67
15	20	122	166	135.55	10	134	148	142.7	5	155	159	157.2
19	25	124	158	135.36	7	135	150	142.71	3	54.000	157	122.33
25	18	126	148	136.39	10	138	156	146.4	4	160	170	163.25
27	22	118	156	136.14	30	140	187	149	8	100	176	151.63
29	7	116	136	125.43	7	144	151	147.29	.	.	.	.
32	4	122	131	128.5	6	142	150	146.33	.	.	.	.
33	9	102	134	123.33	6	142	150	146.17	.	.	.	.
36	5	134	158	143.6	4	140	186	157.5	7	154	232	175
42	9	90.000	166	123.22	4	142	202	163.5	6	158	196	173.5
44N	8	108	168	138.5	6	142	232	158.83	7	156	196	172.57
44S	8	104	154	134.75	6	142	194	156.33	7	152	168	167.71
46	12	105	152	137.33	10	141	196	153.5	5	162	190	172.8

TABLE A4.11 pH

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                                          SAS                                 13:37 FRIDAY, JULY 20, 1984   2
                          PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1970-1982

STATION    SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN     WMIN   WMAX   WMEAN

01         26     7.300  9.000  8.381        27     7.900  9.900  8.522        21     7.400  8.300  7.776
05         23     7.900  8.900  8.400        21     7.800  9.100  8.362        20     7.500  8.100  7.765
08         15     7.900  9.000  8.367        18     7.800  9.000  8.383        15     7.500  8.100  7.760
11         18     8.000  9.100  8.567         9     7.900  8.700  8.356         3     7.300  7.600  7.467
15         31     7.500  8.300  8.297        22     7.700  8.700  8.319        17     7.400  8.200  7.735
19         25     7.500  8.900  8.480         7     7.800  8.600  8.229         3     7.600  7.900  7.733
25         20     7.700  8.700  8.405        18     7.800  8.600  8.333        14     7.600  8.200  7.779
27         42     7.000  9.000  8.345        47     6.900  8.800  8.253        28     6.900  8.100  7.636
29         10     7.500  8.600  8.040        15     8.200  8.700  8.427        10     7.300  8.000  7.690
32          4     7.400  8.600  8.275         7     8.300  8.600  8.457         5     7.400  8.100  7.680
33          9     7.200  8.600  7.911         6     8.300  8.600  8.433         .      .      .      .
36         65     7.100  9.100  8.246        42     7.500  9.000  8.238        54     6.900  8.900  7.806
42         72     5.400  9.200  8.065        35     7.100  8.900  8.231        49     6.800  8.400  7.667
44N        77     6.700  8.800  7.945        42     7.500  8.800  8.102        64     6.900  8.300  7.666
44S        74     7.000  9.000  8.069        42     7.600  9.000  8.319        65     6.200  8.500  7.735
46         58     7.200  9.200  8.112        32     7.500  8.700  8.244        30     7.100  8.300  7.740

                                          SAS                                 10:46 FRIDAY, JULY 20, 1984   2
                          PH SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1981-1982

STATION    SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN     WMIN   WMAX   WMEAN

01         20     7.700  9.000  8.440        18     7.900  8.800  8.556         4     7.400  7.900  7.700
05         18     7.900  8.900  8.456         9     7.800  9.100  8.456         4     7.500  7.600  7.575
08         12     7.900  9.000  8.409         9     7.800  9.000  8.400         4     7.500  7.600  7.550
11         18     8.000  9.100  8.567         9     7.900  8.700  8.356         3     7.300  7.600  7.467
15         20     7.500  8.900  8.370        10     7.700  8.600  8.350         5     7.400  7.900  7.600
19         25     7.500  8.900  8.480         7     7.800  8.600  8.229         3     7.600  7.900  7.733
25         18     7.700  8.700  8.428        10     7.800  8.600  8.330         4     7.600  7.700  7.675
27         22     7.000  9.000  8.341        30     7.700  8.800  8.290         8     7.200  7.800  7.550
29          7     7.500  8.600  8.129         7     8.200  8.700  8.500         .      .      .      .
32          4     7.400  8.600  8.275         6     8.400  8.600  8.483         .      .      .      .
33          9     7.200  8.600  7.911         6     8.300  8.600  8.433         .      .      .      .
36          5     7.100  8.800  8.200         4     7.900  8.300  8.200         7     7.600  7.800  7.714
42          9     7.500  8.600  7.889         4     8.200  8.400  8.275         6     7.500  7.900  7.717
44N         8     7.200  8.600  7.850         6     7.900  8.700  8.217         7     7.400  8.200  7.714
44S         8     7.000  8.800  7.962         6     8.000  8.400  8.250         7     7.500  7.900  7.743
46         12     7.200  8.500  8.008        10     7.900  8.600  8.300         5     7.700  7.900  7.760
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TABLE A4.12 Total Alkalinity (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

TALK SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1973-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	25	104	164	127	27	131	164	145.22	21	120	170	142.81
05	23	100	152	124.39	31	126	236	147.95	20	116	171	135.6
08	14	106	140	127.57	18	134	200	146.61	15	114	171	143.33
11	18	90.000	150	130.17	9	130	142	136.11	3	144	162	150.67
15	31	120	210	137.36	22	126	449	173.73	17	116	331	160.82
19	25	124	158	135.36	7	135	150	142.71	3	54.000	157	122.33
25	20	126	148	136.35	18	138	206	154.39	14	118	186	152.86
27	41	118	166	131.2	47	120	214	151.72	28	100	198	156.29
29	10	116	146	127	15	132	212	158.07	10	134	184	156.6
32	4	122	131	126.5	7	142	208	155.14	5	136	188	163.6
33	9	102	134	123.33	6	142	150	146.17	.	.	.	.
36	64	110	266	145.2	40	108	210	153.45	54	134	299	173.41
42	71	25.000	226	145.9	37	96.000	289	165.65	49	136	260	182.61
44N	74	76.000	460	152.66	43	100	222	160.7	64	130	258	171.27
445	73	10.000	378	140.1	42	104	218	156.36	65	46.000	267	172.8
46	57	105	180	141.46	33	110	212	154.21	30	146	214	172.5

9:24 FRIDAY, SEPTEMBER 28, 1984

SAS

TALK SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	23	104	146	123.85	18	131	152	143.56	4	146	168	155
05	18	100	137	121.44	9	131	148	139.56	4	140	162	147.5
08	12	106	143	128	9	134	141	137.33	4	144	160	150
11	18	90.000	150	130.17	9	130	142	136.11	3	144	162	150.67
15	20	122	166	135.55	10	134	148	142.7	5	155	159	157.2
19	25	124	158	135.36	7	135	150	142.71	3	54.000	157	122.33
25	18	126	148	136.39	10	138	156	146.4	4	160	170	163.25
27	22	118	156	136.14	30	140	187	149	8	100	176	151.63
29	7	116	136	125.43	7	144	151	147.29	.	.	.	.
32	4	122	131	126.5	6	142	150	146.33	.	.	.	.
33	9	102	134	123.33	6	142	153	146.17	.	.	.	.
36	5	134	158	143.6	4	140	186	157.5	7	154	232	175
42	9	98.000	166	123.22	4	142	202	163.5	6	158	196	173.5
44N	8	108	168	138.5	6	142	232	158.03	7	156	196	172.57
445	8	104	154	134.75	6	142	194	156.33	7	152	166	167.71
46	12	105	152	137.33	10	141	196	153.5	5	162	190	172.8

TABLE A4.13 Conductivity (uS/cm)

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                                                                                    8:08 FRIDAY, SEPTEMBER 28, 1984
                     COND SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1970-1982
                                                                                WN     WMIN   WMAX   WMEAN
STATION   SN     SMIN   SMAX   SMEAN         FN     FMIN   FMAX   FMEAN

01        26      190    450  294.69         27      200    400  319.33          21      300    475  360.24
05        24      200    450  293.88         21      250    500  333.29          20      300    500   354.5
08        15      210    350   305.4         18      250    500  331.78          15      300    500  375.33
11        18      260    350  310.78          9      280    350  317.11           3      400    410  406.67
15        31      190    720  355.71         22      250   1100  379.73          17      300    500  406.24
19        25      280    370   340.4          7      330    359  341.14           3      402    418     410
25        20      250    410   336.8         17      300    500  354.41          14      300    500  382.71
27        42      250    500  351.74         46      300    500  361.83          27      300   1190  453.33
29        10      260    450     331         15      250    500  362.87           9      300    600  422.22
32         4      320    350     340          7      351    500  376.14           5      400    550     450
33         9      287    370  335.67          6      353    364  357.17           .        .      .       .
36        64      240    600  362.69         42      250    500  362.76          54      300   2000  460.56
42        71      190    600  375.92         37      250    600  376.41          49      300   1400   468.9
44N       77      220    600  389.36         42      300    750  429.36          64      350    700  498.39
44S       74      200    550  354.99         42      250    600   380.6          65      300    700  442.06
46        58      200    600  356.91         33      270    532  371.15          29      300    600  446.59


                                                                                    9:24 FRIDAY, SEPTEMBER 28, 1984
                                           SAS
                     COND SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1981-1982
                                                                                WN     WMIN   WMAX   WMEAN
STATION   SN     SMIN   SMAX   SMEAN         FN     FMIN   FMAX   FMEAN
                                                                                 4      380    450     410
01        20      229    340   291.6         18      310    356  327.89           4      380    500   422.5
05        18      225    370  291.83          9      290    353  317.67           4      400    500   427.5
08        12      260    350  315.08          9      280    350  319.11           3      400    410  406.67
11        18      260    350  310.78          9      280    350  317.11           5      411    500   448.2
15        20      280    720  368.85         10      318    360   335.4           3      402    418     410
19        25      280    370   340.4          7      330    359  341.14           4      417    500     442
25        18      300    410  338.11          9      326    368  347.22           8      400   1190  539.38
27        22      280    420  339.68         29      310    499  363.93           .        .      .       .
29         7      260    400  315.71          7      340    362  356.14           .        .      .       .
32         4      320    350     340          6      351    359   355.5           .        .      .       .
33         9      287    370  335.67          6      353    364  357.17           7      400    700  496.43
36         5      278    390   319.6          4      330    455     380           6      400    471  425.17
42         9      284    410  333.33          4      339    490   405.5           7      400    544  495.29
44N        8      278    450  363.63          6      360    600     448           7      400    700     471
44S        8      266    380  325.38          5      338    483   399.4           5      400    530   460.2
46        12      266    380  335.25         10      341    532   390.3
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TABLE A4.14 Total Dissolved Solids (mg/L)

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                                                    SAS                                  13:37 FRIDAY, JULY 20, 1984   5
                           TDS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1970-1982

STATION     SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN     WMIN   WMAX   WMEAN

01          17      224    275  247.53        14      266    301   287.5         9      281    399     316
05          15      233    271   248.2         5      272    283   276.4         9      282    313     292
08           8      231    274  251.38         5      271    278     275         4      287    380  326.25
11          18      229    296  262.67         5      265    287   276.2         2      322    401   361.5
15          18      230    323   273.5         5      273    299     285         5      297    412   351.4
19          25      235    324  276.92         7      271    304  284.43         3      333    348  342.33
25          17      238    320  283.41         5      280    320   297.2         5      313    365     345
27          15      244    314   275.2        20      274    324   291.7         6      334    422  360.83
29           7      230    317     261         2      265    300   282.5         1      401    401     401
32           4      250    270  262.75         2      277    290   283.5         1      396    396     396
33           9      228    300  269.22         2      292    298     295         .        .      .       .
36           0        .      .       .         0        .      .       .         2      348    348     348
42           8      222    316  273.13         0        .      .       .         2      505    521     513
44N          4      235    314   272.5         1      270    270     270         2      486    565   525.5
44S          4      229    287  266.75         0        .      .       .         3      355    506  430.33
46           6      234    293   271.5         3      301    331     317         2      497    501     499
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                                                    SAS                                  10:46 FRIDAY, JULY 20, 1984   5
                           TDS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1981-1982

STATION     SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN     WMIN   WMAX   WMEAN

01          17      224    275  247.53        14      266    301   287.5         2      327    333     330
05          15      233    271   248.2         5      272    283   276.4         3      306    313  308.67
08           8      231    274  251.38         5      271    278     275         2      318    320     319
11          18      229    296  262.67         5      265    287   276.2         2      322    401   361.5
15          18      230    323   273.5         5      273    299     285         2      342    348     345
19          25      235    324  276.92         7      271    304  284.43         3      333    348  342.33
25          17      238    320  283.41         5      280    320   297.2         3      342    360     349
27          15      244    314   275.2        19      274    324  292.47         3      334    348  340.67
29           6      238    264  251.67         2      265    300   282.5         .        .      .       .
32           4      250    270  262.75         2      277    290   283.5         .        .      .       .
33           9      228    300  269.22         2      292    298     295         .        .      .       .
36           0        .      .       .         0        .      .       .         0        .      .       .
42           8      222    316  273.13         0        .      .       .         0        .      .       .
44N          4      235    314   272.5         0        .      .       .         0        .      .       .
44S          4      229    287  266.75         0        .      .       .         0        .      .       .
46           6      234    293   271.5         1      301    301     301         0        .      .       .
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TABLE A4.15 Total Hardness (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

THARD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	18	140	176	159.11	14	160	188	176.86	10	160	220	184.4
05	16	136	176	159	5	160	184	165.6	9	168	200	178.22
08	10	136	180	156.8	5	164	172	167.2	5	168	212	195.2
11	18	148	208	171.78	5	160	180	168	3	200	200	200
15	19	144	184	167.58	5	160	180	168.8	6	180	224	205
19	25	148	180	167.52	7	168	192	176	3	200	216	208
25	17	152	196	170.12	5	164	184	168.8	5	192	220	206.4
27	17	148	188	165.88	20	160	196	176.8	7	176	234	213.43
29	7	140	164	150.29	2	168	176	172	1	216	216	216
32	4	148	156	154	2	172	176	174	1	224	224	224
33	9	124	164	148.89	2	176	176	176	.	.	.	.
36	0	.	.	.	0	.	.	.	2	208	220	214
42	8	124	172	150	0	.	.	.	2	260	272	266
44N	4	136	264	182	1	144	144	144	2	242	276	259
44S	5	108	168	144.8	0	.	.	.	3	208	268	232.67
46	7	136	172	154.29	5	172	200	180.8	3	248	256	253.33

SAS

9:24 FRIDAY, SEPTEMBER 28, 1984

THARD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	18	140	176	159.11	14	160	188	176.86	3	196	208	201.33
05	16	136	176	159	5	160	184	165.6	3	184	200	192
08	10	136	160	156.8	5	164	172	167.2	3	192	208	198.67
11	18	148	208	171.78	5	160	180	168	3	200	200	200
15	19	144	184	167.58	5	160	180	168.8	3	204	212	208
19	25	148	180	167.52	7	168	192	176	3	200	216	208
25	17	152	196	170.12	5	164	184	168.8	3	208	220	213.33
27	17	148	188	165.88	19	160	196	177.68	3	216	224	220
29	6	140	156	148	2	168	176	172	.	.	.	.
32	4	148	156	154	2	172	176	174	.	.	.	.
33	9	124	164	148.89	2	176	176	176	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	8	124	172	150	0	.	.	.	0	.	.	.
44N	4	136	264	182	0	.	.	.	0	.	.	.
44S	4	124	168	154	0	.	.	.	0	.	.	.
46	7	136	172	154.29	2	176	180	178	0	.	.	.

TABLE A4.16 Chloride (mg/L)

10:57 THURSDAY, SEPTEMBER 27, 1984

CL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	26	1.900	18.000	3.865	27	0.900	20.000	9.252	21	4.000	23.000	12.238
05	24	1.900	25.000	4.179	21	1.900	33.000	9.995	20	1.900	23.000	11.145
08	15	1.900	15.000	3.620	18	1.900	38.000	9.494	15	2.000	30.000	10.933
11	18	1.900	4.000	2.306	9	4.000	22.000	8.889	3	4.000	6.000	4.667
15	31	1.900	30.000	4.423	22	1.900	148	15.677	17	2.000	38.000	15.000
19	25	1.900	10.000	2.868	7	4.000	12.000	6.571	3	6.000	6.000	6.000
25	20	1.900	17.000	4.230	18	1.900	34.000	10.494	14	2.000	27.000	9.643
27	42	1.900	132	7.776	47	1.900	32.000	8.147	28	4.000	266	21.893
29	10	1.900	22.000	5.590	15	2.000	40.000	11.933	10	4.000	33.000	16.900
32	4	2.000	4.000	2.500	7	2.000	40.000	12.286	5	15.000	46.000	25.400
33	9	2.000	6.000	3.778	6	2.000	18.000	8.333	.	.	.	.
36	64	0.900	23.000	6.986	40	1.900	30.000	9.717	54	2.000	312	20.889
42	71	1.900	150	8.741	37	1.900	68.000	11.269	49	4.000	70.000	19.857
44N	75	1.900	74.000	15.585	43	2.000	80.000	27.721	63	12.000	59.000	34.730
44S	73	1.900	40.000	7.868	43	1.900	84.000	11.902	65	2.000	42.000	15.754
46	57	1.900	31.000	7.679	33	4.000	34.000	10.697	30	6.000	49.000	18.633

SAS

8:35 THURSDAY, SEPTEMBER 27, 1984 7

CL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	20	1.900	4.000	2.380	18	4.000	20.000	10.111	4	4.000	10.000	7.000
05	18	1.900	6.000	2.867	9	4.000	12.000	8.222	4	4.000	12.000	8.500
08	12	1.900	8.000	2.775	9	4.000	12.000	7.333	4	4.000	8.000	6.000
11	18	1.900	4.000	2.306	9	4.000	22.000	8.889	3	4.000	6.000	4.667
15	20	1.900	4.000	2.365	10	4.000	14.000	7.200	5	4.000	16.000	8.800
19	25	1.900	10.000	2.868	7	4.000	12.000	6.571	3	6.000	6.000	6.000
25	18	1.900	14.000	3.533	10	4.000	18.000	8.400	4	2.000	16.000	7.000
27	22	2.000	132	9.727	30	2.000	20.000	7.467	8	4.000	266	39.000
29	7	1.900	4.000	2.843	7	2.000	18.000	7.714	.	.	.	.
32	4	2.000	4.000	2.500	6	2.000	18.000	7.667	.	.	.	.
33	9	2.000	6.000	3.778	6	2.000	18.000	8.333	.	.	.	.
36	5	1.900	18.000	7.960	4	4.000	16.000	7.500	9	2.000	36.000	16.000
42	9	2.000	12.000	6.444	4	2.000	10.000	5.500	6	4.000	10.000	6.667
44N	8	2.000	32.000	12.000	6	6.000	42.000	24.333	7	12.000	36.000	26.286
44S	8	1.900	18.000	5.475	6	4.000	22.000	10.667	7	2.000	16.000	7.429
46	12	2.000	22.000	6.667	10	4.000	34.000	11.800	5	8.000	28.000	15.600

TABLE A4.17 Potassium (mg/L)

K SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	18	1.000	2.000	1.444	14	1.000	2.000	1.500	3	2.000	3.000	2.333
05	16	1.000	2.000	1.375	5	1.000	2.000	1.800	3	2.000	2.000	2.000
08	10	1.000	2.000	1.700	5	1.000	2.000	1.800	3	2.000	2.000	2.000
11	18	1.000	2.000	1.556	7	1.000	2.000	1.857	3	2.000	2.000	2.000
15	19	2.000	3.000	2.105	5	1.000	3.000	1.800	3	2.000	2.000	2.000
19	25	2.000	3.000	2.040	7	1.000	2.000	1.571	3	2.000	2.000	2.000
25	17	2.000	3.000	2.294	4	2.000	3.000	2.500	3	2.000	2.000	2.000
27	15	2.000	3.000	2.267	20	1.000	3.000	1.850	3	2.000	2.000	2.000
29	6	2.000	4.000	3.000	2	2.000	2.000	2.000	0	.	.	.
32	4	2.000	4.000	2.500	2	2.000	2.000	2.000	0	.	.	.
33	9	2.000	5.000	3.778	2	2.000	2.000	2.000	0	.	.	.
36	0	.	.	.	0	.	.	.	2	1.000	1.000	1.000
42	8	2.000	7.000	4.875	0	.	.	.	0	.	.	.
44N	4	2.000	5.000	3.750	1	3.000	3.000	3.000	0	.	.	.
44S	4	2.000	5.000	3.750	1	16.000	16.000	16.000	1	2.000	2.000	2.000
46	6	2.000	6.000	4.500	5	2.000	2.000	2.000	0	.	.	.

K SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	18	1.000	2.000	1.444	14	1.000	2.000	1.500	3	2.000	3.000	2.333
05	16	1.000	2.000	1.375	5	1.000	2.000	1.800	3	2.000	2.000	2.000
08	10	1.000	2.000	1.700	5	1.000	2.000	1.800	3	2.000	2.000	2.000
11	18	1.000	2.000	1.556	7	1.000	2.000	1.857	3	2.000	2.000	2.000
15	19	2.000	3.000	2.105	5	1.000	3.000	1.800	3	2.000	2.000	2.000
19	25	2.000	3.000	2.040	7	1.000	2.000	1.571	3	2.000	2.000	2.000
25	17	2.000	3.000	2.294	4	2.000	3.000	2.500	3	2.000	2.000	2.000
27	15	2.000	3.000	2.267	19	1.000	3.000	1.842	3	2.000	2.000	2.000
29	6	2.000	4.000	3.000	2	2.000	2.000	2.000	.	.	.	.
32	4	2.000	4.000	2.500	2	2.000	2.000	2.000	.	.	.	.
33	9	2.000	5.000	3.778	2	2.000	2.000	2.000	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	8	2.000	7.000	4.875	0	.	.	.	0	.	.	.
44N	4	2.000	5.000	3.750	0	.	.	.	0	.	.	.
44S	4	2.000	5.000	3.750	0	.	.	.	0	.	.	.
46	6	2.000	6.000	4.500	2	2.000	2.000	2.000	0	.	.	.

TABLE A4.18 Sodium (mg/L)

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                    NA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                      8:08 FRIDAY, SEPTEMBER 28, 1984
                                       1970-1982

STATION    SN     SMIN     SMAX    SMEAN          FN     FMIN     FMAX    FMEAN          WN     WMIN     WMAX    WMEAN

01         21    4.000   23.000    8.714          20    5.000   19.000   10.900          12    7.000   26.000   14.417
05         18    4.000   22.000    8.556          11    6.000   33.000   12.909          10    7.000   12.000   10.200
08         12    3.000   22.000    8.167          11    6.000   33.000   12.636           6    8.000   23.000   11.667
11         18    3.000   10.000    6.944           7    6.000    8.000    6.857           3    7.000    8.000    7.667
15         22    4.000   80.000   11.682          11    5.000      198   29.818           7    9.000   28.000   14.429
19         25    4.000   59.000   10.160           7    6.000    8.000    7.143           3    9.000   10.000    9.333
25         18    5.000   28.000   10.667          10    8.000   34.000   16.000           6    9.000   22.000   13.000
27         18    5.000   41.000   15.222          25    0.020   40.000   13.321          10   10.000   35.000   20.500
29          9    8.000   34.000   14.556           7   12.000   40.000   22.571           4   14.000   28.000   24.500
32          4    9.000   11.000   10.000           3   12.000   39.000   21.667           3   17.000   28.000   23.667
33          9   11.000   14.000   12.222           2   11.000   13.000   12.000           .        .        .        .
36         44    7.000   37.000   21.364          24    7.000   39.000   20.792          35    8.000      324   28.943
42         70    6.000   42.000   19.186          35    7.000   34.000   17.886          44    9.000   73.000   23.614
44N        72    7.000   60.000   25.319          39   11.000   60.000   29.051          58   13.000   60.000   32.638
44S        58    6.000   42.000   21.397          25   10.000   39.000   20.640          37   11.000   44.000   24.189
46         53    6.000   39.000   18.311          29    9.000   27.000   16.276          30   11.000   54.000   22.767


                                                  SAS
                    NA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                      9:24 FRIDAY, SEPTEMBER 28, 1984
                                       1981-1982

STATION    SN     SMIN     SMAX    SMEAN          FN     FMIN     FMAX    FMEAN          WN     WMIN     WMAX    WMEAN

01         18    4.000   10.000    7.111          14    5.000   13.000    9.143           3    7.000   11.000    8.333
05         16    4.000   10.000    7.250           5    6.000    8.000    6.800           3    7.000   12.000    9.000
08         10    3.000   11.000    6.300           5    6.000    8.000    6.600           3    8.000    8.000    8.000
11         18    3.000   10.000    6.944           7    6.000    8.000    6.857           3    7.000    8.000    7.667
15         19    4.000   11.000    7.316           5    5.000   10.000    7.600           3    9.000   10.000    9.667
19         25    4.000   59.000   10.160           7    6.000    8.000    7.143           3    9.000   10.000    9.333
25         17    5.000   18.000    9.647           5    8.000   11.000    9.400           3    9.000   10.000    9.667
27         15    5.000   38.000   12.467          19    0.020   13.000   10.843           3   10.000   10.000   10.000
29          6    8.000   11.000    9.167           2   12.000   13.000   12.500           .        .        .        .
32          4    7.000   11.000   10.000           2   12.000   14.000   13.000           .        .        .        .
33          9   11.000   14.000   12.222           2   11.000   13.000   12.000           .        .        .        .
36          0        .        .        .           0        .        .        .           0        .        .        .
42          9   11.000   16.000   12.667           3    9.000   15.000   11.667           6    9.000   15.000   11.167
44N         8    8.000   34.000   16.375           4   22.000   35.000   27.500           7   18.000   31.000   25.000
44S         4    9.000   13.000   11.500           1   10.000   10.000   10.000           0        .        .        .
46         13    7.000   22.000   12.600           6   11.000   26.000   14.667           5   12.000   25.000   18.600
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TABLE A4.19 Magnesium (mg/L)

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                                                                                          10:57 THURSDAY, SEPTEMBER 27, 1984    9
                        MG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                           1970-1982

STATION    SN      SMIN    SMAX    SMEAN        FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01         17    10.000  20.000  15.118         13     7.000  17.000  14.154           8    10.000  19.000  15.000
05         15    12.000  21.000  15.333          5    10.000  17.000  12.400           9    15.000  19.000  16.889
08         10    11.000  18.000  14.400          5     7.000  16.000  12.600           4    16.000  21.000  17.500
11         18    11.000  24.000  16.444          5    12.000  16.000  14.200           2    17.000  18.000  17.500
15         18    10.000  19.000  14.778          5    10.000  17.000  14.200           4    15.000  21.000  17.750
19         23    11.000  18.000  14.696          5    11.000  20.000  14.200           3    17.000  19.000  18.000
25         16    12.000  21.000  15.250          5     9.000  13.000  11.400           5    16.000  19.000  18.200
27         13    13.000  17.000  14.462         19     5.000  29.000  17.947           4    18.000  21.000  19.250
29          7    12.000  18.000  15.143          2    16.000  19.000  17.500           0      .       .       .
32          4    13.000  16.000  14.250          2     8.000  17.000  12.500           0      .       .       .
33          9    10.000  15.000  13.111          2    17.000  17.000  17.000           .      .       .       .
36          0      .       .       .             0      .       .       .              2    22.000  22.000  22.000
42          8     9.000  17.000  13.125          0      .       .       .              0      .       .       .
44N         4     8.000  17.000  13.250          1    13.000  13.000  13.000           0      .       .       .
44S         4     9.000  16.000  13.250          0      .       .       .              1    21.000  21.000  21.000
46          6    13.000  19.000  15.500          4    17.000  18.000  17.500           0      .       .       .


                                              SAS                                         8:35 THURSDAY, SEPTEMBER 27, 1984    9
                        MG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                           1981-1982

STATION    SN      SMIN    SMAX    SMEAN        FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01         17    10.000  20.000  15.118         13     7.000  17.000  14.154           2    17.000  19.000  18.000
05         15    12.000  21.000  15.333          5    10.000  17.000  12.400           3    15.000  19.000  17.000
08         10    11.000  18.000  14.400          5     7.000  16.000  12.600           2    16.000  17.000  16.500
11         18    11.000  24.000  16.444          5    12.000  16.000  14.200           2    17.000  18.000  17.500
15         18    10.000  19.000  14.778          5    10.000  17.000  14.200           2    17.000  21.000  19.000
19         23    11.000  18.000  14.696          5    11.000  20.000  14.200           3    17.000  19.000  18.000
25         16    12.000  21.000  15.250          5     9.000  13.000  11.400           3    18.000  19.000  18.667
27         13    13.000  17.000  14.462         18     5.000  29.000  18.167           2    19.000  21.000  20.000
29          6    12.000  17.000  14.667          2    16.000  19.000  17.500           .      .       .       .
32          4    13.000  16.000  14.250          2     8.000  17.000  12.500           .      .       .       .
33          9    10.000  15.000  13.111          2    17.000  17.000  17.000           .      .       .       .
36          0      .       .       .             0      .       .       .              0      .       .       .
42          8     9.000  17.000  13.125          0      .       .       .              0      .       .       .
44N         4     8.000  17.000  13.250          0      .       .       .              0      .       .       .
44S         4     9.000  16.000  13.250          0      .       .       .              0      .       .       .
46          6    13.000  19.000  15.500          2    17.000  18.000  17.500           0      .       .       .
```

TABLE A4.20 Sulphate (mg/L)

10:57 THURSDAY, SEPTEMBER 27, 1984 10

SO4 SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	21	20.000	66.000	41.048	20	24.000	52.000	39.550	12	40.000	68.000	50.333
05	16	28.000	68.000	44.000	12	20.000	82.000	42.333	10	42.000	59.000	46.200
08	12	28.000	64.000	40.167	11	35.000	82.000	46.273	5	43.000	60.000	52.800
11	18	24.000	51.000	41.556	5	35.000	40.000	38.600	3	61.000	62.000	61.667
15	22	28.000	160	50.455	12	20.000	340	69.333	7	44.000	68.000	56.857
19	25	28.000	71.000	46.520	7	31.000	46.000	39.143	3	60.000	68.000	64.000
25	18	28.000	74.000	49.056	10	33.000	78.000	47.900	6	44.000	64.000	56.167
27	20	40.000	112	52.950	25	33.000	98.000	44.160	11	44.000	86.000	60.909
29	9	32.000	94.000	52.667	7	40.000	93.000	59.429	4	49.000	86.000	73.750
32	4	36.000	40.000	39.000	3	40.000	90.000	56.667	3	60.000	78.000	70.333
33	9	40.000	64.000	49.778	2	40.000	51.000	45.500	.	.	.	.
36	44	23.000	100	55.636	24	30.000	96.000	57.833	35	50.000	230	69.114
42	70	20.000	101	56.700	35	27.000	93.000	55.400	43	40.000	970	88.186
44N	73	15.000	142	57.014	39	38.000	135	60.051	57	44.000	124	69.491
44S	57	20.000	94.000	51.842	26	20.000	110	58.615	35	9.000	180	72.429
46	54	20.000	94.000	50.852	28	29.000	72.000	49.786	29	44.000	104	65.310

SAS

8:35 THURSDAY, SEPTEMBER 27, 1984 11

SO4 SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	18	20.000	51.000	39.167	14	24.000	40.000	38.000	3	40.000	60.000	52.333
05	16	28.000	53.000	42.000	6	20.000	40.000	35.333	3	42.000	59.000	50.333
08	10	28.000	47.000	37.000	5	35.000	40.000	38.600	2	59.000	60.000	59.500
11	18	24.000	51.000	41.556	5	35.000	40.000	38.600	3	61.000	62.000	61.667
15	19	28.000	55.000	43.895	6	20.000	44.000	35.667	3	60.000	68.000	63.333
19	25	28.000	71.000	46.520	7	31.000	46.000	39.143	3	60.000	68.000	64.000
25	17	28.000	65.000	47.588	5	33.000	44.000	39.400	3	60.000	64.000	61.333
27	16	40.000	61.000	47.438	19	33.000	45.000	39.263	3	60.000	63.000	61.667
29	6	32.000	45.000	37.667	2	40.000	40.000	40.000	.	.	.	.
32	4	36.000	40.000	39.000	2	40.000	40.000	40.000	.	.	.	.
33	9	40.000	64.000	49.778	2	40.000	51.000	45.500	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	9	36.000	72.000	54.444	3	40.000	64.000	48.000	6	44.000	64.000	53.833
44N	8	38.000	62.000	47.750	4	40.000	64.000	46.500	7	52.000	80.000	62.000
44S	4	38.000	48.000	42.000	1	40.000	40.000	40.000	0	.	.	.
46	10	20.000	67.000	49.500	5	40.000	48.000	42.000	4	44.000	62.000	53.500

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                         TABLE A4.21  Calcium (mg/L)                               10:57 THURSDAY, SEPTEMBER 27, 1984   10
               CA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1970-1982

STATION    SN    SMIN   SMAX   SMEAN          FN    FMIN   FMAX   FMEAN          WN    WMIN   WMAX   WMEAN

01         17   32.000 46.000 39.000          14   40.000 53.000 47.429          8   42.000 64.000 47.500
05         15   32.000 46.000 38.600           5   45.000 48.000 46.400          9   40.000 50.000 44.111
08         10   34.000 48.000 39.400           5   43.000 54.000 46.600          4   42.000 51.000 48.500
11         18   29.000 51.000 41.667           5   42.000 48.000 44.600          2   50.000    132 91.000
15         18   38.000 46.000 42.833           5   43.000 51.000 45.600          4   42.000 56.000 50.250
19         24   14.000 48.000 42.292           5   45.000 58.000 49.000          3   51.000 56.000 52.667
25         17   13.000 50.000 41.824           5   45.000 54.000 49.200          5   45.000 56.000 52.000
27         14   38.000 50.000 42.571          19   24.000 48.000 39.789          4   42.000 54.000 49.500
29          7   34.000 38.000 35.857           2   40.000 42.000 41.000          0        .      .      .
32          4   37.000 40.000 38.750           2   43.000 43.000 43.000          0        .      .      .
33          9   34.000 42.000 38.556           2   43.000 43.000 43.000          .        .      .      .
36          0        .      .      .           0        .      .      .          2   46.000 51.000 48.500
42          8   34.000 48.000 39.000           0        .      .      .          0        .      .      .
44N         4   37.000 45.000 40.500           1   37.000 37.000 37.000          0        .      .      .
44S         4   35.000 43.000 40.000           0        .      .      .          1   48.000 48.000 48.000
46          6   32.000 45.000 35.167           4   38.000 43.000 41.750          0        .      .      .


                                              SAS                                  8:35 THURSDAY, SEPTEMBER 27, 1984   10
               CA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                   1981-1982

STATION    SN    SMIN   SMAX   SMEAN          FN    FMIN   FMAX   FMEAN          WN    WMIN   WMAX   WMEAN

01         17   32.000 46.000 39.000          14   40.000 53.000 47.429          2   50.000 51.000 50.500
05         15   32.000 46.000 38.600           5   45.000 48.000 46.400          3   48.000 50.000 48.667
08         10   34.000 48.000 39.400           5   43.000 54.000 46.600          2   51.000 51.000 51.000
11         18   29.000 51.000 41.667           5   42.000 48.000 44.600          2   50.000    132 91.000
15         18   38.000 46.000 42.833           5   43.000 51.000 45.600          2   50.000 53.000 51.500
19         24   14.000 48.000 42.292           5   45.000 58.000 49.000          3   51.000 56.000 52.667
25         17   13.000 50.000 41.824           5   45.000 54.000 49.200          3   51.000 56.000 53.667
27         14   38.000 50.000 42.571          18   24.000 48.000 39.778          2   51.000 51.000 51.000
29          6   34.000 38.000 35.667           2   40.000 42.000 41.000          .        .      .      .
32          4   37.000 40.000 38.750           2   43.000 43.000 43.000          .        .      .      .
33          9   34.000 42.000 38.556           2   43.000 43.000 43.000          .        .      .      .
36          0        .      .      .           0        .      .      .          0        .      .      .
42          8   34.000 48.000 39.000           0        .      .      .          0        .      .      .
44N         4   37.000 45.000 40.500           0        .      .      .          0        .      .      .
44S         4   35.000 43.000 40.000           0        .      .      .          0        .      .      .
46          6   32.000 45.000 35.167           2   43.000 43.000 43.000          0        .      .      .
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TABLE A4.22 Apparent Colour (colour units)

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                                                  SAS                                            13:37 FRIDAY, JULY 20, 1984   1
                         APPCOLOR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                              1970-1982

STATION    SN       SMIN    SMAX    SMEAN           FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01          3      7.000  20.000  14.667             1     6.000   6.000   6.000            1     5.000   5.000   5.000
05          3      4.000  19.000  10.667             1     5.000   5.000   5.000            1     6.000   6.000   6.000
08          2      4.000  20.000  12.000             1     4.000   4.000   4.000            1     5.000   5.000   5.000
11          3      7.000  13.000  10.667             1     5.000   5.000   5.000            1     6.000   6.000   6.000
15          3     12.000  14.000  13.000             1     5.000   5.000   5.000            1     6.000   6.000   6.000
19          4      8.000  17.000  13.250             1     5.000   5.000   5.000            1     7.000   7.000   7.000
25          3      6.000  13.000   9.333             1     6.000   6.000   6.000            1     0.049   0.049   0.049
27          5      6.000  15.000  11.400             1     6.000   6.000   6.000            1     6.000   6.000   6.000
29          2     13.000     134  73.500             0         .       .       .            0         .       .       .
32          2     14.000  71.000  42.500             0         .       .       .            0         .       .       .
33          1     13.000  13.000  13.000             0         .       .       .            .         .       .       .
36          1     13.000  13.000  13.000             1     5.000   5.000   5.000            0         .       .       .
42          2     10.000  17.000  13.500             6     6.000  38.000  15.500            6     6.000  11.000   7.667
44N         5     32.000     320  97.400             7    20.000  73.000  52.429            8     9.000  97.000  42.750
44S         4     14.000  69.000  28.250             6     0.900  19.000   9.650            7     5.000   9.000   6.929
46          6     16.000  28.000  21.500             6     9.000  38.000  17.667            5    12.000  23.000  16.200
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                                                  SAS                                            10:46 FRIDAY, JULY 20, 1984   1
                         APPCOLOR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                              1981-1982

STATION    SN       SMIN    SMAX    SMEAN           FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01          3      7.000  20.000  14.667             1     6.000   6.000   6.000            1     5.000   5.000   5.000
05          3      4.000  19.000  10.667             1     5.000   5.000   5.000            1     6.000   6.000   6.000
08          2      4.000  20.000  12.000             1     4.000   4.000   4.000            1     5.000   5.000   5.000
11          3      7.000  13.000  10.667             1     5.000   5.000   5.000            1     6.000   6.000   6.000
15          3     12.000  14.000  13.000             1     5.000   5.000   5.000            1     6.000   6.000   6.000
19          4      8.000  17.000  13.250             1     5.000   5.000   5.000            1     7.000   7.000   7.000
25          3      6.000  13.000   9.333             1     6.000   6.000   6.000            1     0.049   0.049   0.049
27          5      6.000  15.000  11.400             1     6.000   6.000   6.000            1     6.000   6.000   6.000
29          2     13.000     134  73.500             0         .       .       .            .         .       .       .
32          2     14.000  71.000  42.500             0         .       .       .            .         .       .       .
33          1     13.000  13.000  13.000             0         .       .       .            .         .       .       .
36          1     13.000  13.000  13.000             1     5.000   5.000   5.000            0         .       .       .
42          2     10.000  17.000  13.500             3     6.000  15.000  10.000            6     6.000  11.000   7.667
44N         5     32.000     320  97.400             4    35.000  70.000  57.250            7    15.000  97.000  47.571
44S         4     14.000  69.000  28.250             3     0.900  14.000   6.967            7     5.000   9.000   6.929
46          6     16.000  28.000  21.500             4     9.000  38.000  17.000            3    14.000  23.000  17.667
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TABLE A4.23 Total Suspended Solids (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

TSS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	26	15.000	1268	196.4	27	3.000	37.000	13.796	20	3.000	23.000	12.750
05	24	8.000	1470	197.02	21	2.000	80.000	21.643	19	3.000	29.500	14.211
08	15	21.000	1824	282.8	18	3.000	39.500	17.667	14	4.000	43.000	14.179
11	17	22.000	317	83.765	9	10.000	39.000	23.000	3	5.000	6.000	5.333
15	29	33.000	1498	264.05	22	4.000	74.000	24.750	15	4.000	26.000	13.700
19	25	57.000	1622	281.72	7	7.000	32.000	17.286	3	9.000	16.000	12.333
25	20	39.000	796	213.35	18	3.000	148	36.111	13	5.000	29.000	10.923
27	41	12.000	642	96.934	46	6.000	442	48.163	26	4.000	104	13.731
29	10	11.500	1165	318.3	15	4.000	162	44.367	9	6.000	40.000	13.056
32	4	64.000	140	86.250	7	12.000	46.000	27.286	4	6.000	28.500	13.125
33	9	60.000	1154	377.44	6	22.000	30.000	25.333	.	.	.	.
36	65	7.500	1277	150.86	38	5.000	196	31.605	52	4.000	80.000	13.467
42	72	6.000	1564	227.42	37	2.000	324	44.824	47	2.000	292	20.636
44N	76	13.000	1992	217.56	43	13.000	198	40.605	62	3.000	112	21.661
44S	73	4.000	1580	182.52	43	7.000	279	36.140	63	2.000	222	13.254
46	58	16.000	1018	199.81	33	5.000	111	28.758	30	3.000	33.000	11.800

9:24 FRIDAY, SEPTEMBER 28, 1984

SAS

TSS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	20	15.000	1268	182.95	18	6.000	35.000	13.444	4	3.000	11.000	6.500
05	18	8.000	1470	205.28	9	6.000	53.000	20.111	4	5.000	9.000	6.000
08	12	21.000	1824	267.25	9	6.000	30.000	17.889	4	5.000	17.000	9.250
11	17	22.000	317	83.165	9	10.000	39.000	23.000	3	5.000	6.000	5.333
15	20	48.000	1498	331.75	10	4.000	34.000	22.800	5	9.000	26.000	15.600
19	25	57.000	1622	281.72	7	7.000	32.000	17.286	3	9.000	16.000	12.333
25	18	39.000	796	217.89	10	3.000	148	41.800	4	9.000	22.000	12.500
27	22	18.000	642	88.591	29	9.000	442	52.793	8	5.000	104	21.000
29	7	51.000	1165	441.29	7	23.000	162	54.286	.	.	.	.
32	4	64.000	140	86.250	6	21.000	46.000	29.833	.	.	.	.
33	9	60.000	1154	377.44	6	22.000	30.000	25.333	.	.	.	.
36	5	28.000	550	163.2	4	8.000	20.000	13.000	7	6.000	45.000	18.429
42	9	53.000	776	351.89	4	14.000	26.000	18.000	6	6.000	92.000	22.000
44N	8	50.000	758	237.13	6	13.000	26.000	20.667	7	5.000	85.000	22.143
44S	8	41.000	670	232.25	6	7.000	31.000	19.000	7	4.000	12.000	8.714
46	12	47.000	956	338.67	10	11.000	39.000	25.500	5	6.000	15.000	9.600

TABLE A4.24 Turbidity (JTU)

SAS   13:37 FRIDAY, JULY 20, 1984   4

TURB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	6	4.400	450	101.42	1	5.500	5.500	5.500	1	1.000	1.000	1.000
05	5	5.500	450	119.52	1	1.700	1.700	1.700	1	1.500	1.500	1.500
08	4	8.100	490	151.65	1	2.700	2.700	2.700	1	1.400	1.400	1.400
11	6	7.700	500	106.48	1	6.500	6.500	6.500	1	1.600	1.600	1.600
15	5	20.000	230	122.8	1	6.700	6.700	6.700	1	3.900	3.900	3.900
19	6	15.000	160	81.167	1	5.400	5.400	5.400	1	4.800	4.800	4.800
25	5	9.000	230	77.400	1	11.000	11.000	11.000	1	3.000	3.000	3.000
27	7	0.700	39.000	17.300	1	5.600	5.600	5.600	0	.	.	.
29	2	20.000	250	135	0	.	.	.	0	.	.	.
32	2	17.000	93.000	55.000	0	.	.	.	0	.	.	.
33	7	19.000	220	123.43	0	.	.	.	0	.	.	.
36	0	.	.	.	1	2.800	2.800	2.800	0	.	.	.
42	8	14.000	220	125.5	0	.	.	.	1	0.009	0.009	0.009
44N	3	100	200	136.67	0	.	.	.	0	.	.	.
44S	2	100	210	155	0	.	.	.	0	.	.	.
46	6	19.000	220	124	0	.	.	.	0	.	.	.

SAS   10:46 FRIDAY, JULY 20, 1984   4

TURB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	6	4.400	450	101.42	1	5.500	5.500	5.500	1	1.000	1.000	1.000
05	5	5.500	450	119.52	1	1.700	1.700	1.700	1	1.500	1.500	1.500
08	4	8.100	490	151.65	1	2.700	2.700	2.700	1	1.400	1.400	1.400
11	6	7.700	500	106.48	1	6.500	6.500	6.500	1	1.600	1.600	1.600
15	5	20.000	230	122.8	1	6.700	6.700	6.700	1	3.900	3.900	3.900
19	6	15.000	160	81.167	1	5.400	5.400	5.400	1	4.800	4.800	4.800
25	5	9.000	230	77.400	1	11.000	11.000	11.000	1	3.000	3.000	3.000
27	7	0.700	39.000	17.300	1	5.600	5.600	5.600	0	.	.	.
29	2	20.000	250	135	0	.	.	.	.	.	.	.
32	2	17.000	93.000	55.000	0	.	.	.	.	.	.	.
33	7	19.000	220	123.43	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	8	14.000	220	125.5	0	.	.	.	1	0.009	0.009	0.009
44N	3	100	200	136.67	0	.	.	.	0	.	.	.
44S	2	100	210	155	0	.	.	.	0	.	.	.
46	6	19.000	220	124	0	.	.	.	0	.	.	.

8:08 FRIDAY, SEPTEMBER 28, 1984

TABLE A4.25 Aluminum, Total (mg/L)

AL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.450	6.400	3.150	3	0.360	0.580	0.457	1	0.150	0.150	0.150
05	3	0.660	3.800	1.920	3	0.480	0.510	0.490	1	0.070	0.070	0.070
08	2	2.000	3.000	2.500	3	0.370	0.580	0.460	1	0.080	0.080	0.080
11	3	0.820	3.700	2.173	3	0.310	1.200	0.693	1	0.100	0.100	0.100
15	3	0.480	8.800	4.093	3	0.240	0.740	0.450	1	0.070	0.070	0.070
19	4	0.780	7.000	3.320	5	0.240	0.900	0.520	1	0.130	0.130	0.130
25	3	1.200	3.700	2.133	3	0.710	1.000	0.817	1	0.170	0.170	0.170
27	13	0.180	3.100	1.114	8	0.340	0.980	0.631	7	0.130	1.800	0.490
29	2	1.700	23.000	12.350	2	0.680	1.300	0.990	0	.	.	.
32	2	1.400	3.600	2.500	2	0.280	0.900	0.590	0	.	.	.
33	1	1.100	1.100	1.100	2	0.630	1.300	0.965	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.110	0.110	0.110
42	1	1.600	1.600	1.600	0	.	.	.	0	.	.	.
44N	1	5.200	5.200	5.200	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	9	0.260	11.000	2.204	3	0.600	1.200	0.913	2	0.760	1.400	1.080

9:24 FRIDAY, SEPTEMBER 28, 1984 1

SAS

AL SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.450	6.400	3.150	3	0.360	0.580	0.457	1	0.150	0.150	0.150
05	3	0.660	3.800	1.920	3	0.480	0.510	0.490	1	0.070	0.070	0.070
08	2	2.000	3.000	2.500	3	0.370	0.580	0.460	1	0.080	0.080	0.080
11	3	0.820	3.700	2.173	3	0.310	1.200	0.693	1	0.100	0.100	0.100
15	3	0.480	8.800	4.093	3	0.240	0.740	0.450	1	0.070	0.070	0.070
19	4	0.780	7.000	3.320	5	0.240	0.900	0.520	1	0.130	0.130	0.130
25	3	1.200	3.700	2.133	3	0.710	1.000	0.817	1	0.170	0.170	0.170
27	8	0.550	1.700	0.945	7	0.340	0.980	0.659	4	0.140	1.800	0.745
29	2	1.700	23.000	12.350	2	0.680	1.300	0.990	.	.	.	.
32	2	1.400	3.600	2.500	2	0.280	0.900	0.590	.	.	.	.
33	1	1.100	1.100	1.100	2	0.630	1.300	0.965	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.110	0.110	0.110
42	1	1.600	1.600	1.600	0	.	.	.	0	.	.	.
44N	1	5.200	5.200	5.200	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	4	0.680	11.000	3.845	2	0.940	1.200	1.070	2	0.760	1.400	1.080

TABLE A4.26 Arsenic, Total (ug/L)

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                                               SAS
                      AS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                     13:24 THURSDAY, JULY 12, 1984    5
                                           1970-1982

STATION    SN     SMIN    SMAX    SMEAN           FN     FMIN    FMAX    FMEAN          WN     WMIN    WMAX    WMEAN

01          3    0.700   3.900   1.800             2    0.490   0.600   0.545           1    0.600   0.600   0.600
05          3    0.800   3.100   1.933             2    0.490   0.600   0.545           1    0.600   0.600   0.600
08          2    1.000   1.400   1.200             2    0.700   5.400   3.050           1    0.900   0.900   0.900
11          3    0.700   1.800   1.100             2    0.500   0.700   0.600           1    1.300   1.300   1.300
15          3    1.000   3.600   2.000             2    0.490   0.600   0.545           1    0.900   0.800   0.900
17          4    0.900   4.200   1.975             3    0.490   0.700   0.597           1    0.490   0.490   0.490
25          3    0.900   1.400   1.133             2    0.490   1.300   0.895           1    0.500   0.500   0.500
27         13    0.500  14.000   2.522             8    0.490   1.100   0.722           7    0.490   2.500   1.210
29          2    0.700   6.500   3.600             2    0.490   2.000   1.245           0      .       .       .
32          2    0.700   2.400   1.550             2    0.490   0.800   0.645           0      .       .       .
33          1    0.700   0.700   0.700             2    0.490   0.500   0.495           .      .       .       .
36          0      .       .       .               1    1.000   1.000   1.000           1    0.490   0.490   0.490
42          1    0.600   0.600   0.600             0      .       .       .             0      .       .       .
44N         1    2.800   2.800   2.800             0      .       .       .             0      .       .       .
44S         0      .       .       .               0      .       .       .             0      .       .       .
46          9    0.600   4.000   1.931             3    0.490   2.000   0.993           2    1.000   2.000   1.500
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                                                SAS
                      AS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                     13:15 MONDAY, JULY 16, 1984    1
                                           1981-1982

STATION    SN     SMIN    SMAX    SMEAN           FN     FMIN    FMAX    FMEAN          WN     WMIN    WMAX    WMEAN

01          3    0.700   3.900   1.800             2    0.490   0.600   0.545           1    0.600   0.600   0.600
05          3    0.800   3.100   1.933             2    0.490   0.600   0.545           1    0.600   0.600   0.600
08          2    1.000   1.400   1.200             2    0.700   5.400   3.050           1    0.900   0.900   0.900
11          3    0.700   1.800   1.100             2    0.500   0.700   0.600           1    1.300   1.300   1.300
15          3    1.000   3.600   2.000             2    0.490   0.600   0.545           1    0.800   0.800   0.800
17          4    0.900   4.200   1.975             3    0.490   0.700   0.597           1    0.490   0.490   0.490
25          3    0.900   1.400   1.133             2    0.490   1.300   0.895           1    0.500   0.500   0.500
27          4    0.500   2.000   1.225             7    0.490   1.100   0.756           4    0.600   2.500   1.500
29          2    0.700   6.500   3.600             2    0.490   2.000   1.245           .      .       .       .
32          2    0.700   2.400   1.550             2    0.490   0.800   0.645           .      .       .       .
33          1    0.700   0.700   0.700             2    0.490   0.500   0.495           .      .       .       .
35          0      .       .       .               0      .       .       .             1    0.490   0.490   0.490
42          1    0.600   0.600   0.600             0      .       .       .             0      .       .       .
44N         1    2.900   2.900   2.900             0      .       .       .             0      .       .       .
44S         0      .       .       .               0      .       .       .             0      .       .       .
46          4    0.600   4.000   2.400             2    0.490   2.000   1.245           2    1.000   2.000   1.500
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TABLE A4.27 Barium, Total (mg/L)

8:35 MONDAY, JULY 16, 1984 1

BA SUMMARY GOING DOWNSTREAM OF THE ^{SAS}N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.060	0.140	0.103	3	0.064	0.089	0.077	1	0.072	0.072	0.072
05	3	0.003	0.110	0.069	3	0.063	0.084	0.070	1	0.062	0.062	0.062
03	2	0.095	0.100	0.097	3	0.066	0.080	0.073	1	0.070	0.070	0.070
11	3	0.056	0.085	0.066	3	0.028	0.064	0.051	1	0.057	0.057	0.057
15	3	0.009	0.180	0.087	3	0.061	0.080	0.069	0	.	.	.
19	4	0.082	0.180	0.113	5	0.024	0.100	0.062	0	.	.	.
25	3	0.088	0.093	0.091	2	0.068	0.075	0.071	0	.	.	.
27	9	0.044	0.220	0.092	6	0.063	0.140	0.084	0	.	.	.
29	2	0.030	0.200	0.140	2	0.065	0.069	0.067	0	.	.	.
32	2	0.077	0.110	0.093	2	0.068	0.160	0.114	0	.	.	.
33	1	0.076	0.076	0.076	2	0.070	0.140	0.105	.	.	.	.
35	0	.	.	.	0	.	.	.	1	0.042	0.042	0.042
42	1	0.087	0.087	0.087	0	.	.	.	0	.	.	.
44N	1	0.140	0.140	0.140	0	.	.	.	0	.	.	.
443	0	.	.	.	0	.	.	.	0	.	.	.
45	2	0.097	0.440	0.263	2	0.068	0.074	0.071	0	.	.	.

8:46 MONDAY, JULY 16, 1984 1

BA SUMMARY GOING DOWNSTREAM OF THE ^{SAS}N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SPEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.050	0.140	0.103	3	0.064	0.089	0.077	1	0.072	0.072	0.072
05	3	0.005	0.110	0.068	3	0.063	0.084	0.070	1	0.062	0.062	0.062
03	2	0.093	0.100	0.097	3	0.056	0.090	0.073	1	0.070	0.070	0.070
11	3	0.056	0.085	0.066	3	0.028	0.064	0.051	1	0.057	0.057	0.057
15	3	0.039	0.180	0.087	3	0.061	0.080	0.069	0	.	.	.
19	4	0.082	0.180	0.113	5	0.024	0.100	0.062	0	.	.	.
25	3	0.038	0.093	0.091	2	0.058	0.075	0.071	0	.	.	.
27	9	0.044	0.220	0.092	6	0.063	0.140	0.084	0	.	.	.
29	2	0.080	0.200	0.140	2	0.065	0.069	0.067	.	.	.	.
32	2	0.077	0.110	0.093	2	0.058	0.160	0.114	.	.	.	.
33	1	0.076	0.075	0.075	2	0.070	0.140	0.105	.	.	.	.
35	0	.	.	.	0	.	.	.	1	0.042	0.042	0.042
42	1	0.037	0.037	0.087	0	.	.	.	0	.	.	.
44N	1	0.140	0.140	0.140	0	.	.	.	0	.	.	.
443	0	.	.	.	0	.	.	.	0	.	.	.
46	2	0.097	0.440	0.263	2	0.058	0.074	0.071	0	.	.	.

TABLE A4.28 Boron, Total (mg/L)

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                                                        SAS                                                              8:35 MONDAY, JULY 16, 1984    2
                       B SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                                1970-1982

STATION    SN     SMIN    SMAX    SMEAN          FN     FMIN    FMAX    FMEAN          WN     WMIN    WMAX    WMEAN

01          1     0.009   0.009   0.009           2     0.009   0.020   0.014           0       .       .       .
02          1     0.010   0.010   0.010           2     0.020   0.020   0.020           0       .       .       .
03          1     0.009   0.009   0.009           2     0.010   0.020   0.015           0       .       .       .
11          1     0.009   0.009   0.009           2     0.009   0.020   0.014           0       .       .       .
15          1     0.010   0.010   0.010           2     0.020   0.020   0.020           1     0.020   0.020   0.020
19          1     0.009   0.009   0.009           4     0.020   0.020   0.020           1     0.020   0.020   0.020
25          1     0.009   0.009   0.009           2     0.020   0.030   0.025           1     0.030   0.030   0.030
27          5     0.010   0.090   0.042           6     0.020   0.060   0.035           3     0.030   0.100   0.060
29          1     0.009   0.009   0.009           2     0.020   0.030   0.025           0       .       .       .
32          1     0.020   0.020   0.020           2     0.040   0.130   0.085           0       .       .       .
33          0       .       .       .             2     0.020   0.040   0.030           .       .       .       .
36          0       .       .       .             0       .       .       .             1     0.010   0.010   0.010
42          0       .       .       .             0       .       .       .             0       .       .       .
44N         1     0.010   0.010   0.010           0       .       .       .             0       .       .       .
44S         0       .       .       .             0       .       .       .             0       .       .       .
46          3     0.009   0.080   0.036           2     0.010   0.010   0.010           0       .       .       .


                                                        SAS                                                              8:46 MONDAY, JULY 16, 1984    2
                       B SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                                1981-1982

STATION    SN     SMIN    SMAX    SMEAN          FN     FMIN    FMAX    FMEAN          WN     WMIN    WMAX    WMEAN

01          1     0.009   0.009   0.009           2     0.009   0.020   0.014           0       .       .       .
02          1     0.010   0.010   0.010           2     0.020   0.020   0.020           0       .       .       .
03          1     0.009   0.009   0.009           2     0.010   0.020   0.015           0       .       .       .
11          1     0.009   0.009   0.009           2     0.009   0.020   0.014           0       .       .       .
15          1     0.010   0.010   0.010           2     0.020   0.020   0.020           1     0.020   0.020   0.020
19          1     0.009   0.009   0.009           4     0.020   0.020   0.020           1     0.020   0.020   0.020
25          1     0.009   0.009   0.009           2     0.020   0.030   0.025           1     0.030   0.030   0.030
27          4     0.010   0.030   0.035           6     0.020   0.060   0.035           1     0.030   0.030   0.030
29          1     0.009   0.009   0.009           2     0.020   0.030   0.025           .       .       .       .
32          1     0.020   0.020   0.020           2     0.040   0.130   0.085           .       .       .       .
33          0       .       .       .             2     0.020   0.040   0.030           .       .       .       .
36          0       .       .       .             0       .       .       .             1     0.010   0.010   0.010
42          0       .       .       .             0       .       .       .             0       .       .       .
44N         1     0.010   0.010   0.010           0       .       .       .             0       .       .       .
44S         0       .       .       .             0       .       .       .             0       .       .       .
46          2     0.009   0.020   0.014           2     0.010   0.010   0.010           0       .       .       .
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TABLE A4.29 Cadmium Total (mg/L)

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                                                   SAS                                            8:35 MONDAY, JULY 16, 1984    3

                    CD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1970-1982

STATION   SN    SMIN   SMAX   SMEAN      FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

  01       3   0.000  0.001  0.001        3   0.000  0.001  0.001         1   0.001  0.001  0.001
  05       3   0.000  0.006  0.002        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  09       2   0.000  0.031  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  11       3   0.000  0.039  0.013        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  15       3   0.000  0.002  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  19       4   0.000  0.001  0.001        5   0.000  0.001  0.001         1   0.000  0.000  0.000
  25       3   0.000  0.001  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  27      15   0.000  0.090  0.017       10   0.000  0.090  0.010         7   0.000  0.090  0.019
  29       2   0.000  0.001  0.001        2   0.001  0.001  0.001         0     .      .      .
  32       2   0.000  0.001  0.001        2   0.001  0.001  0.001         0     .      .      .
  33       1   0.000  0.000  0.000        2   0.001  0.001  0.001         .     .      .      .
  36       0     .      .      .          1   0.000  0.000  0.000         1   0.001  0.001  0.001
  42       1   0.000  0.000  0.000        1   0.090  0.090  0.090         0     .      .      .
  44N      1   0.001  0.001  0.001        0     .      .      .           0     .      .      .
  44S      0     .      .      .          0     .      .      .           0     .      .      .
  46       9   0.000  0.090  0.019        4   0.001  0.090  0.024         2   0.005  0.019  0.012
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                                                   SAS                                            8:46 MONDAY, JULY 16, 1984    1

                    CD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                    1981-1982

STATION   SN    SMIN   SMAX   SMEAN      FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

  01       3   0.000  0.001  0.001        3   0.000  0.001  0.001         1   0.001  0.001  0.001
  05       3   0.000  0.006  0.002        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  09       2   0.000  0.031  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  11       3   0.000  0.039  0.013        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  15       3   0.000  0.002  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  19       4   0.000  0.001  0.001        5   0.000  0.001  0.001         1   0.000  0.000  0.000
  25       3   0.000  0.001  0.001        3   0.000  0.001  0.001         1   0.000  0.000  0.000
  27      10   0.000  0.019  0.003        8   0.000  0.001  0.001         4   0.000  0.019  0.005
  29       2   0.000  0.001  0.001        2   0.001  0.001  0.001         .     .      .      .
  32       2   0.000  0.001  0.001        2   0.001  0.001  0.001         .     .      .      .
  33       1   0.000  0.000  0.000        2   0.001  0.001  0.001         .     .      .      .
  36       0     .      .      .          0     .      .      .           1   0.001  0.001  0.001
  42       1   0.000  0.000  0.000        0     .      .      .           0     .      .      .
  44N      1   0.001  0.001  0.001        0     .      .      .           0     .      .      .
  44S      0     .      .      .          0     .      .      .           0     .      .      .
  46       5   0.000  0.019  0.004        2   0.001  0.001  0.001         2   0.005  0.019  0.012
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TABLE A4.30 Chromium, Total (mg/L)

SAS

CR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

8:35 MONDAY, JULY 16, 1984 4

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.004	0.014	0.009	3	0.002	0.003	0.003	1	0.005	0.005	0.005
05	3	0.001	0.012	0.007	3	0.003	0.005	0.004	1	0.003	0.003	0.003
09	2	0.006	0.012	0.009	3	0.003	0.005	0.004	1	0.003	0.003	0.003
11	3	0.002	0.009	0.005	3	0.004	0.005	0.004	1	0.002	0.002	0.002
15	3	0.009	0.019	0.013	3	0.003	0.004	0.004	1	0.005	0.005	0.005
17	4	0.013	0.018	0.015	5	0.003	0.022	0.008	1	0.005	0.005	0.005
23	3	0.005	0.019	0.013	3	0.005	0.018	0.009	1	0.005	0.005	0.005
27	15	0.001	0.088	0.018	10	0.001	0.012	0.005	7	0.001	0.016	0.006
29	2	0.011	0.027	0.017	2	0.004	0.011	0.007	0	.	.	.
32	2	0.007	0.011	0.009	2	0.004	0.007	0.005	0	.	.	.
33	1	0.012	0.012	0.012	2	0.003	0.006	0.004	.	.	.	.
36	0	.	.	.	1	0.001	0.001	0.001	1	0.003	0.003	0.003
42	1	0.001	0.001	0.001	1	0.016	0.016	0.016	0	.	.	.
44N	1	0.014	0.014	0.014	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	10	0.001	0.025	0.008	4	0.003	0.014	0.007	2	0.007	0.011	0.009

SAS

CR SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

8:46 MONDAY, JULY 16, 1984 4

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.004	0.014	0.007	3	0.002	0.003	0.003	1	0.005	0.005	0.005
05	3	0.001	0.012	0.007	3	0.003	0.005	0.004	1	0.003	0.003	0.003
09	2	0.005	0.012	0.009	3	0.003	0.005	0.004	1	0.003	0.003	0.003
11	3	0.002	0.009	0.005	3	0.004	0.005	0.004	1	0.002	0.002	0.002
15	3	0.007	0.019	0.013	3	0.003	0.004	0.004	1	0.005	0.005	0.005
17	4	0.013	0.018	0.015	5	0.003	0.022	0.008	1	0.005	0.005	0.005
23	3	0.005	0.019	0.013	3	0.005	0.019	0.009	1	0.005	0.005	0.005
27	10	0.003	0.070	0.016	8	0.001	0.007	0.004	4	0.005	0.016	0.009
29	2	0.011	0.027	0.019	2	0.004	0.011	0.007	.	.	.	.
32	2	0.007	0.011	0.009	2	0.004	0.007	0.005	.	.	.	.
33	1	0.012	0.012	0.012	2	0.003	0.006	0.004	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.003	0.003	0.003
42	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44N	1	0.014	0.014	0.014	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	5	0.001	0.025	0.013	2	0.004	0.005	0.004	2	0.007	0.011	0.009

TABLE A4.31 Cobalt, Total (mg/L)

SAS

8:35 MONDAY, JULY 16, 1984 5

CO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.001	0.004	0.002	3	0.001	0.001	0.001	1	0.001	0.001	0.001
02	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.002	0.002	0.002
03	2	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.001	0.001	0.001
11	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.001	0.001	0.001
15	3	0.001	0.004	0.003	3	0.001	0.001	0.001	1	0.002	0.002	0.002
19	4	0.001	0.004	0.002	5	0.001	0.001	0.001	1	0.002	0.002	0.002
25	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.002	0.002	0.002
27	11	0.001	0.090	0.009	10	0.001	0.006	0.002	3	0.001	0.004	0.002
29	2	0.001	0.010	0.005	2	0.001	0.001	0.001	0	.	.	.
32	2	0.001	0.002	0.001	2	0.001	0.001	0.001	0	.	.	.
33	1	0.001	0.001	0.001	2	0.001	0.001	0.001	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.001	0.001	0.001
42	1	0.001	0.001	0.001	1	0.003	0.003	0.003	0	.	.	.
44N	1	0.002	0.002	0.002	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	6	0.001	0.090	0.017	4	0.001	0.011	0.004	1	0.001	0.001	0.001

SAS

8:46 MONDAY, JULY 16, 1984 5

CO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.001	0.004	0.002	3	0.001	0.001	0.001	1	0.001	0.001	0.001
05	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.002	0.002	0.002
03	2	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.001	0.001	0.001
11	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.001	0.001	0.001
15	3	0.001	0.004	0.003	3	0.001	0.001	0.001	1	0.002	0.002	0.002
19	4	0.001	0.004	0.002	5	0.001	0.001	0.001	1	0.002	0.002	0.002
25	3	0.001	0.002	0.001	3	0.001	0.001	0.001	1	0.002	0.002	0.002
27	9	0.001	0.002	0.001	8	0.001	0.001	0.001	3	0.001	0.004	0.002
29	2	0.001	0.010	0.005	2	0.001	0.001	0.001	.	.	.	.
32	2	0.001	0.002	0.001	2	0.001	0.001	0.001	.	.	.	.
33	1	0.001	0.001	0.001	2	0.001	0.001	0.001	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.001	0.001	0.001
42	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44N	1	0.002	0.002	0.002	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	4	0.001	0.016	0.002	2	0.001	0.001	0.001	1	0.001	0.001	0.001

TABLE A4.32 Copper, Total (mg/L)

SAS

CU SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	4	0.005	0.021	0.013	3	0.005	0.016	0.009	1	0.018	0.018	0.019
05	3	0.005	0.016	0.012	3	0.006	0.009	0.008	1	0.006	0.006	0.006
08	2	0.009	0.011	0.009	3	0.006	0.009	0.008	1	0.007	0.007	0.007
11	4	0.009	0.010	0.009	3	0.005	0.013	0.008	1	0.005	0.005	0.005
15	3	0.014	0.018	0.015	3	0.009	0.014	0.011	1	0.003	0.003	0.003
19	4	0.011	0.170	0.073	5	0.005	0.022	0.011	1	0.014	0.014	0.014
25	4	0.013	0.025	0.019	3	0.008	0.015	0.012	1	0.008	0.008	0.008
27	19	0.002	0.041	0.011	10	0.003	0.064	0.016	7	0.002	0.039	0.013
29	2	0.007	0.031	0.019	2	0.014	0.014	0.014	0	.	.	.
32	2	0.008	0.021	0.014	2	0.008	0.014	0.011	0	.	.	.
33	1	0.007	0.007	0.007	2	0.007	0.007	0.007	.	.	.	.
36	0	.	.	.	1	0.048	0.048	0.048	1	0.004	0.004	0.004
42	1	0.037	0.037	0.037	1	0.007	0.007	0.007	0	.	.	.
44N	1	0.015	0.016	0.016	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	10	0.002	0.035	0.014	4	0.006	0.015	0.010	2	0.002	0.005	0.003

SAS

CU SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

8:46 MONDAY, JULY 16, 1984 6

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	4	0.005	0.021	0.013	3	0.005	0.016	0.009	1	0.018	0.018	0.018
05	3	0.005	0.016	0.012	3	0.009	0.009	0.009	1	0.006	0.006	0.006
08	2	0.008	0.011	0.009	3	0.006	0.009	0.009	1	0.007	0.007	0.007
11	4	0.008	0.010	0.009	3	0.005	0.013	0.008	1	0.005	0.005	0.005
15	3	0.014	0.018	0.016	3	0.009	0.014	0.011	1	0.003	0.003	0.003
19	4	0.011	0.170	0.073	5	0.005	0.022	0.011	1	0.014	0.014	0.014
25	4	0.013	0.025	0.019	3	0.008	0.015	0.012	1	0.008	0.008	0.009
27	13	0.002	0.038	0.009	8	0.003	0.064	0.018	4	0.002	0.014	0.009
29	2	0.007	0.031	0.019	2	0.014	0.014	0.014	.	.	.	.
32	2	0.009	0.021	0.014	2	0.008	0.014	0.011	.	.	.	.
33	1	0.007	0.007	0.007	2	0.007	0.007	0.007	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.004	0.004	0.004
42	1	0.037	0.037	0.037	0	.	.	.	0	.	.	.
44N	1	0.016	0.016	0.016	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	5	0.002	0.028	0.015	2	0.006	0.008	0.007	2	0.002	0.005	0.003

TABLE A4.33 Cyanide, Total (ug/L)

SAS

13:24 THURSDAY, JULY 12, 1984 4

CN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.090	3.000	1.060	3	0.200	1.100	0.733	1	0.300	0.300	0.300
05	3	0.090	13.000	5.030	3	0.500	2.500	1.300	1	0.400	0.400	0.400
08	2	0.090	0.090	0.090	3	0.400	1.500	0.800	1	0.600	0.600	0.600
11	3	0.090	2.000	0.727	3	0.300	5.500	2.033	1	1.000	1.000	1.000
15	3	4.500	12.000	8.600	3	0.300	3.000	1.267	1	0.090	0.090	0.090
19	4	0.100	6.000	3.100	5	0.300	3.000	1.130	1	0.090	0.090	0.090
25	3	0.090	16.000	5.830	3	0.600	1.500	0.900	1	0.900	0.900	0.900
27	11	0.090	5.000	1.761	8	0.090	9.000	2.199	6	0.090	4.100	1.628
29	2	0.090	4.000	2.045	2	0.400	7.000	3.700	0	.	.	.
32	2	1.000	4.500	2.750	2	0.800	2.000	1.400	0	.	.	.
33	1	0.090	0.090	0.090	2	0.090	0.100	0.095	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.700	0.700	0.700
42	1	0.090	0.090	0.090	0	.	.	.	0	.	.	.
44N	1	8.000	8.000	8.000	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	8	0.090	6.000	1.692	3	0.300	4.500	1.800	2	0.090	2.000	1.045

SAS

13:15 MONDAY, JULY 16, 1984 2

CN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.090	3.000	1.060	3	0.200	1.100	0.733	1	0.300	0.300	0.300
05	3	0.090	13.000	5.030	3	0.500	2.500	1.300	1	0.400	0.400	0.400
09	2	0.090	0.090	0.090	3	0.400	1.500	0.800	1	0.600	0.600	0.600
11	3	0.090	2.000	0.727	3	0.300	5.500	2.033	1	1.000	1.000	1.000
15	3	4.500	12.000	8.600	3	0.300	3.000	1.267	1	0.090	0.090	0.090
19	4	0.100	6.000	3.100	5	0.300	3.000	1.130	1	0.090	0.090	0.090
25	3	0.090	16.000	5.830	3	0.600	1.500	0.900	1	0.900	0.900	0.900
27	9	0.090	5.000	2.160	7	0.090	9.000	2.255	4	0.090	4.100	2.297
29	2	0.090	4.000	2.045	2	0.400	7.000	3.700	.	.	.	.
32	2	1.000	4.500	2.750	2	0.800	2.000	1.400	.	.	.	.
33	1	0.090	0.090	0.090	2	0.090	0.100	0.095	.	.	.	.
35	0	.	.	.	0	.	.	.	1	0.700	0.700	0.700
42	1	0.090	0.090	0.090	0	.	.	.	0	.	.	.
44N	1	8.000	8.000	8.000	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
45	4	0.090	6.000	2.422	2	0.300	0.500	0.400	2	0.090	2.000	1.045

TABLE A4.34 Lead, Total (mg/L)

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                                               SAS
            PB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                 8:35 MONDAY, JULY 16, 1984    7
                                      1970-1982

STATION   SN    SMIN   SMAX   SMEAN       FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01         3   0.002  0.007  0.005         3   0.002  0.005  0.004         1   0.016  0.016  0.016
05         3   0.002  0.007  0.005         3   0.005  0.006  0.005         1   0.013  0.013  0.013
09         2   0.005  0.014  0.009         3   0.002  0.005  0.004         1   0.011  0.011  0.011
11         3   0.004  0.007  0.005         3   0.002  0.005  0.004         1   0.003  0.003  0.003
15         3   0.005  0.022  0.011         3   0.003  0.005  0.004         1   0.019  0.019  0.019
17         4   0.002  0.026  0.014         5   0.005  0.009  0.006         1   0.019  0.019  0.019
25         3   0.005  0.014  0.010         3   0.004  0.005  0.005         1   0.019 /0.019  0.019
27        15   0.002  0.039  0.007        10   0.002  0.013  0.005         7   0.002  0.068  0.020
29         2   0.005  0.006  0.005         2   0.005  0.005  0.005         0     .      .      .
32         2   0.004  0.005  0.004         2   0.005  0.014  0.009         0     .      .      .
33         1   0.004  0.004  0.004         2   0.005  0.005  0.005         .     .      .      .
36         0     .      .      .           1   0.002  0.002  0.002         1   0.005  0.005  0.005
42         1   0.008  0.008  0.008         1   0.002  0.002  0.002         0     .      .      .
44N        1   0.005  0.005  0.005         0     .      .      .           0     .      .      .
44S        0     .      .      .           0     .      .      .           0     .      .      .
46        10   0.002  0.032  0.008         4   0.005  0.016  0.010         2   0.002  0.043  0.022
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                                               SAS
            PB SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                 8:46 MONDAY, JULY 16, 1984    7
                                      1981-1982

STATION   SN    SMIN   SMAX   SMEAN       FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01         3   0.002  0.007  0.005         3   0.002  0.005  0.004         1   0.016  0.016  0.016
05         3   0.002  0.007  0.005         3   0.005  0.005  0.005         1   0.013  0.013  0.013
09         2   0.005  0.014  0.009         3   0.002  0.003  0.004         1   0.011  0.011  0.011
11         3   0.004  0.007  0.005         3   0.002  0.005  0.004         1   0.003  0.003  0.003
15         3   0.005  0.022  0.011         3   0.003  0.005  0.004         1   0.019  0.019  0.019
17         4   0.002  0.026  0.014         5   0.005  0.009  0.006         1   0.019  0.019  0.019
25         3   0.005  0.014  0.010         3   0.004  0.005  0.005         1   0.019  0.019  0.019
27        10   0.002  0.008  0.005         8   0.002  0.005  0.004         4   0.002  0.068  0.030
29         2   0.005  0.006  0.005         2   0.005  0.005  0.005         .     .      .      .
32         2   0.004  0.005  0.004         2   0.005  0.014  0.009         .     .      .      .
33         1   0.004  0.004  0.004         2   0.005  0.005  0.005         .     .      .      .
36         0     .      .      .           0     .      .      .           1   0.005  0.005  0.005
42         1   0.008  0.008  0.008         0     .      .      .           0     .      .      .
44N        1   0.005  0.005  0.005         0     .      .      .           0     .      .      .
44S        0     .      .      .           0     .      .      .           0     .      .      .
45         5   0.003  0.012  0.009         2   0.005  0.014  0.009         2   0.002  0.043  0.022
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TABLE A4.35 Mercury, Total (ug/L)

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                                                     SAS                                     13:24 THURSDAY, JULY 12, 1984    3
                     HG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1970-1982

STATION     SN      SMIN    SMAX    SMEAN          FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01           3      0.019   0.250   0.096           3      0.019   0.050   0.029           1      0.019   0.019   0.019
05           3      0.019   0.210   0.083           3      0.019   0.060   0.033           1      0.019   0.019   0.019
08           2      0.019   0.020   0.019           3      0.019   0.030   0.023           1      0.019   0.019   0.019
11           3      0.020   0.260   0.100           3      0.019   0.050   0.040           1      0.019   0.019   0.019
15           3      0.019   0.240   0.093           3      0.019   0.020   0.019           1      0.019   0.019   0.019
19           4      0.019   0.200   0.092           5      0.019   0.020   0.020           1      0.019   0.019   0.019
25           3      0.020   0.270   0.110           3      0.019   0.020   0.020           1      0.019   0.019   0.019
27          13      0.019   0.350   0.091          10      0.019   0.090   0.029           7      0.019   0.110   0.070
29           2      0.019   0.020   0.019           2      0.019   0.019   0.019           0        .       .       .
32           2      0.019   0.040   0.029           2      0.019   0.020   0.019           0        .       .       .
33           1      0.019   0.019   0.019           2      0.019   0.020   0.019           .        .       .       .
36           6      0.030   0.090   0.080           3      0.019   0.090   0.053           6      0.019   0.200   0.085
42           5      0.020   0.099   0.078           4      0.020   0.090   0.062           1      0.019   0.019   0.019
44N          1      0.040   0.040   0.040           0        .       .       .             0        .       .       .
44S          0        .       .       .             0        .       .       .             0        .       .       .
46          11      0.019   0.250   0.099           6      0.019   0.090   0.041           2      0.019   0.110   0.064



                                                     SAS                                     13:15 MONDAY, JULY 16, 1984    3
                     HG SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                        1981-1982

STATION     SN      SMIN    SMAX    SMEAN          FN      FMIN    FMAX    FMEAN          WN      WMIN    WMAX    WMEAN

01           3      0.019   0.250   0.096           3      0.019   0.050   0.029           1      0.019   0.019   0.019
05           3      0.019   0.210   0.083           3      0.019   0.060   0.033           1      0.019   0.019   0.019
09           2      0.019   0.020   0.019           3      0.019   0.030   0.023           1      0.019   0.019   0.019
11           3      0.020   0.260   0.100           3      0.019   0.050   0.040           1      0.019   0.019   0.019
15           3      0.019   0.240   0.093           3      0.019   0.020   0.019           1      0.019   0.019   0.019
19           4      0.019   0.200   0.092           5      0.019   0.020   0.020           1      0.019   0.019   0.019
25           3      0.020   0.270   0.110           3      0.019   0.020   0.020           1      0.019   0.019   0.019
27           8      0.019   0.350   0.088           8      0.019   0.020   0.019           4      0.019   0.110   0.049
29           2      0.019   0.020   0.019           2      0.019   0.019   0.019           .        .       .       .
32           2      0.019   0.040   0.029           2      0.019   0.020   0.019           .        .       .       .
33           1      0.019   0.019   0.019           2      0.019   0.020   0.019           .        .       .       .
35           1      0.030   0.030   0.030           2      0.019   0.090   0.054           2      0.019   0.019   0.019
42           1      0.020   0.020   0.020           1      0.020   0.020   0.020           1      0.019   0.019   0.019
44N          1      0.040   0.040   0.040           0        .       .       .             0        .       .       .
44S          0        .       .       .             0        .       .       .             0        .       .       .
45           4      0.019   0.220   0.075           3      0.019   0.020   0.019           2      0.019   0.110   0.064
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TABLE A4.36 Molybdenum, Total (mg/L)

SAS 13:24 THURSDAY, JULY 12, 1984 1

MO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
05	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
08	2	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
11	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
15	3	0.005	0.006	0.005	3	0.005	0.005	0.005	1	0.002	0.002	0.002
19	4	0.005	0.005	0.005	5	0.005	0.005	0.005	1	0.002	0.002	0.002
25	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.002	0.002	0.002
27	7	0.005	0.005	0.005	7	0.005	0.005	0.005	1	0.002	0.002	0.002
29	2	0.005	0.017	0.011	2	0.005	0.005	0.005	0	.	.	.
32	2	0.005	0.005	0.005	2	0.005	0.005	0.005	0	.	.	.
33	1	0.005	0.005	0.005	2	0.005	0.005	0.005	.	.	.	.
35	0	.	.	.	0	.	.	.	1	0.005	0.005	0.005
42	1	0.005	0.005	0.005	0	.	.	.	0	.	.	.
44N	1	0.005	0.005	0.005	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	0.005	0.010	0.007	2	0.005	0.005	0.005	0	.	.	.

SAS 8:58 MONDAY, JULY 16, 1984 1

MO SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
05	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
08	2	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
11	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.005	0.005	0.005
15	3	0.005	0.006	0.005	3	0.005	0.005	0.005	1	0.002	0.002	0.002
19	4	0.005	0.005	0.005	5	0.005	0.005	0.005	1	0.002	0.002	0.002
25	3	0.005	0.005	0.005	3	0.005	0.005	0.005	1	0.002	0.002	0.002
27	7	0.005	0.005	0.005	7	0.005	0.005	0.005	1	0.002	0.002	0.002
29	2	0.005	0.017	0.011	2	0.005	0.005	0.005	.	.	.	.
32	2	0.005	0.005	0.005	2	0.005	0.005	0.005	.	.	.	.
33	1	0.005	0.005	0.005	2	0.005	0.005	0.005	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.005	0.005	0.005
42	1	0.005	0.005	0.005	0	.	.	.	0	.	.	.
44N	1	0.005	0.005	0.005	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	0.005	0.010	0.007	2	0.005	0.005	0.005	0	.	.	.

TABLE A4.37 Nickel, Total (mg/L)

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                                                         SAS                                   8:35 MONDAY, JULY 16, 1984    8
                              NI SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1970-1982

STATION   SN    SMIN   SMAX   SMEAN        FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01         3   0.005  0.012  0.008          3   0.003  0.010  0.007         1   0.017  0.017  0.017
05         3   0.004  0.016  0.010          3   0.005  0.006  0.005         1   0.004  0.004  0.004
09         2   0.005  0.012  0.008          3   0.002  0.005  0.004         1   0.005  0.005  0.005
11         3   0.006  0.010  0.008          3   0.002  0.110  0.039         1   0.003  0.003  0.003
15         3   0.002  0.038  0.018          3   0.004  0.005  0.005         1   0.009  0.009  0.009
19         4   0.002  0.068  0.024          5   0.004  0.027  0.011         1   0.009  0.009  0.009
25         3   0.005  0.120  0.044          3   0.004  0.005  0.005         1   0.009  0.009  0.009
27        14   0.001  0.210  0.026         10   0.001  0.012  0.005         5   0.002  0.129  0.032
29         2   0.006  0.032  0.019          2   0.006  0.007  0.006         0    .      .      .
32         2   0.006  0.010  0.008          2   0.003  0.008  0.005         0    .      .      .
33         1   0.004  0.004  0.004          2   0.003  0.003  0.003         .    .      .      .
36         0    .      .      .             1   0.005  0.005  0.005         1   0.001  0.001  0.001
42         1   0.006  0.006  0.006          1   0.005  0.005  0.005         0    .      .      .
44N        1   0.012  0.012  0.012          0    .      .      .            0    .      .      .
44S        0    .      .      .             0    .      .      .            0    .      .      .
46         9   0.004  0.026  0.013          4   0.004  0.008  0.006         2   0.001  0.010  0.005
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                                                         SAS                                   8:46 MONDAY, JULY 16, 1984    9
                              NI SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                             1981-1982

STATION   SN    SMIN   SMAX   SMEAN        FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01         3   0.005  0.012  0.009          3   0.003  0.010  0.007         1   0.017  0.017  0.017
05         3   0.004  0.016  0.010          3   0.005  0.005  0.005         1   0.004  0.004  0.004
09         2   0.005  0.012  0.008          3   0.002  0.005  0.004         1   0.005  0.005  0.005
11         3   0.006  0.010  0.008          3   0.002  0.110  0.039         1   0.003  0.003  0.003
15         3   0.002  0.038  0.018          3   0.004  0.005  0.005         1   0.009  0.009  0.009
19         4   0.002  0.068  0.024          5   0.004  0.027  0.011         1   0.009  0.009  0.009
25         3   0.005  0.120  0.044          3   0.004  0.006  0.005         1   0.009  0.009  0.009
27        10   0.001  0.210  0.029          8   0.001  0.012  0.005         4   0.002  0.129  0.039
29         2   0.006  0.032  0.019          2   0.006  0.007  0.006         .    .      .      .
32         2   0.006  0.010  0.008          2   0.003  0.008  0.005         .    .      .      .
33         1   0.004  0.004  0.004          2   0.003  0.003  0.003         .    .      .      .
36         0    .      .      .             0    .      .      .            1   0.001  0.001  0.001
42         1   0.006  0.006  0.006          0    .      .      .            0    .      .      .
44N        1   0.012  0.012  0.012          0    .      .      .            0    .      .      .
44S        0    .      .      .             0    .      .      .            0    .      .      .
46         5   0.004  0.026  0.014          2   0.004  0.006  0.005         2   0.001  0.010  0.005
```

TABLE A4.38 Selenium, Total (mg/L)

SAS
SE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

12:24 THURSDAY, JULY 12, 1984 8

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
05	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
09	2	0.001	0.009	0.005	1	0.001	0.001	0.001	1	0.001	0.001	0.001
11	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
15	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
19	4	0.001	0.009	0.003	1	0.003	0.003	0.003	1	0.001	0.001	0.001
25	3	0.001	0.009	0.004	1	0.002	0.002	0.002	1	0.001	0.001	0.001
27	7	0.001	0.009	0.006	2	0.001	0.001	0.001	1	0.002	0.002	0.002
29	2	0.001	0.009	0.005	0	.	.	.	0	.	.	.
32	2	0.001	0.009	0.005	0	.	.	.	0	.	.	.
33	1	0.001	0.001	0.001	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.001	0.001	0.001
42	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44N	1	0.009	0.009	0.009	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	0.001	0.009	0.005	0	.	.	.	0	.	.	.

SAS
SE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

9:58 MONDAY, JULY 16, 1984 1

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
05	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
09	2	0.001	0.009	0.005	1	0.001	0.001	0.001	1	0.001	0.001	0.001
11	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
15	3	0.001	0.009	0.004	1	0.001	0.001	0.001	1	0.001	0.001	0.001
19	4	0.001	0.009	0.003	1	0.003	0.003	0.003	1	0.001	0.001	0.001
25	3	0.001	0.009	0.004	1	0.002	0.002	0.002	1	0.001	0.001	0.001
27	7	0.001	0.009	0.006	2	0.001	0.001	0.001	1	0.002	0.002	0.002
29	2	0.001	0.009	0.005	0	.	.	.	.	.	.	.
32	2	0.001	0.009	0.005	0	.	.	.	.	.	.	.
33	1	0.001	0.001	0.001	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.001	0.001	0.001
42	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44N	1	0.009	0.009	0.009	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	0.001	0.009	0.005	0	.	.	.	0	.	.	.

TABLE A4.39 Silver, Total (mg/L)

AG SUMMARY GOING DOWNSTREAM OF THE ^{SAS}N.SASK.RIVER
1970-1982

8:35 MONDAY, JULY 16, 1984 9

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
05	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
08	1	0.001	0.001	0.001	2	0.001	0.003	0.002	0	.	.	.
11	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
15	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
19	1	0.001	0.001	0.001	4	0.001	0.002	0.001	0	.	.	.
25	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
27	4	0.001	0.001	0.001	7	0.001	0.090	0.014	1	0.090	0.090	0.090
29	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
32	1	0.001	0.001	0.001	2	0.002	0.002	0.002	0	.	.	.
33	0	.	.	.	2	0.001	0.001	0.001	.	.	.	.
35	0	.	.	.	1	0.000	0.000	0.000	1	0.001	0.001	0.001
42	0	.	.	.	1	0.090	0.090	0.090	0	.	.	.
44N	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	1	0.001	0.001	0.001	3	0.001	0.090	0.031	0	.	.	.

AG SUMMARY GOING DOWNSTREAM OF THE ^{SAS}N.SASK.RIVER
1981-1982

8:46 MONDAY, JULY 16, 1984 9

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
05	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
08	1	0.001	0.001	0.001	2	0.001	0.003	0.002	0	.	.	.
11	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
15	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
19	1	0.001	0.001	0.001	4	0.001	0.002	0.001	0	.	.	.
25	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.
27	4	0.001	0.001	0.001	6	0.001	0.002	0.001	0	.	.	.
29	1	0.001	0.001	0.001	2	0.001	0.001	0.001	.	.	.	.
32	1	0.001	0.001	0.001	2	0.002	0.002	0.002	.	.	.	.
33	0	.	.	.	2	0.001	0.001	0.001	.	.	.	.
35	0	.	.	.	0	.	.	.	1	0.001	0.001	0.001
42	0	.	.	.	0	.	.	.	0	.	.	.
44N	1	0.001	0.001	0.001	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	1	0.001	0.001	0.001	2	0.001	0.001	0.001	0	.	.	.

TABLE A4.40 Uranium, Total (ug/L)

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                                                    SAS
                U SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                    13:24 THURSDAY, JULY 12, 1984    9
                                   1970-1982
STATION   SN    SMIN    SMAX    SMEAN      FN   FMIN   FMAX   FMEAN      WN   WMIN    WMAX    WMEAN

01        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
05        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
09        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
11        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
15        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
19        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
25        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
27        4    0.009   0.010   0.010       0     .      .      .         0     .       .       .
29        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
32        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
33        0      .       .       .         0     .      .      .         .     .       .       .
36        0      .       .       .         0     .      .      .         1   2.300   2.300   2.300
42        0      .       .       .         0     .      .      .         0     .       .       .
44N       1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
44S       0      .       .       .         0     .      .      .         0     .       .       .
45        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .


                                                    SAS
                U SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                    9:58 MONDAY, JULY 16, 1984    5
                                   1981-1982
STATION   SN    SMIN    SMAX    SMEAN      FN   FMIN   FMAX   FMEAN      WN   WMIN    WMAX    WMEAN

01        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
05        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
09        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
11        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
15        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
19        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
25        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
27        4    0.009   0.010   0.010       0     .      .      .         0     .       .       .
29        1    0.010   0.010   0.010       0     .      .      .         .     .       .       .
32        1    0.010   0.010   0.010       0     .      .      .         .     .       .       .
33        0      .       .       .         0     .      .      .         .     .       .       .
36        0      .       .       .         0     .      .      .         1   2.300   2.300   2.300
42        0      .       .       .         0     .      .      .         0     .       .       .
44N       1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
44S       0      .       .       .         0     .      .      .         0     .       .       .
46        1    0.010   0.010   0.010       0     .      .      .         0     .       .       .
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TABLE A4.41 Vanadium, Total (mg/L)

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                                                       SAS
        V SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                         13:24 THURSDAY, JULY 12, 1984     6
                                1970-1982

STATION     SN     SMIN   SMAX   SMEAN           FN     FMIN   FMAX   FMEAN          WN     WMIN   WMAX   WMEAN

01           3    0.009  0.020  0.013             3    0.009  0.009  0.009          1    0.010  0.010  0.010
02           3    0.009  0.010  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
03           2    0.009  0.010  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
11           3    0.009  0.009  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
15           3    0.009  0.020  0.013             3    0.009  0.009  0.009          1    0.003  0.003  0.003
19           4    0.009  0.020  0.012             5    0.009  0.009  0.009          1    0.004  0.004  0.004
25           3    0.009  0.009  0.009             3    0.009  0.009  0.009          1    0.004  0.004  0.004
27           7    0.009  0.010  0.009             7    0.009  0.010  0.009          1    0.004  0.004  0.004
29           2    0.009  0.040  0.024             2    0.009  0.009  0.009          0      .      .      .
32           2    0.009  0.010  0.009             2    0.009  0.009  0.009          0      .      .      .
33           1    0.009  0.009  0.009             2    0.009  0.009  0.009          .      .      .      .
36           0      .      .      .               0      .      .      .            1    0.009  0.009  0.009
42           1    0.009  0.009  0.009             0      .      .      .            0      .      .      .
44A          1    0.020  0.020  0.020             0      .      .      .            0      .      .      .
44B          0      .      .      .               0      .      .      .            0      .      .      .
46           2    0.009  0.027  0.018             2    0.009  0.009  0.009          0      .      .      .
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                                                       SAS
        V SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                          8:58 MONDAY, JULY 16, 1984     6
                                1981-1982

STATION     SN     SMIN   SMAX   SMEAN           FN     FMIN   FMAX   FMEAN          WN     WMIN   WMAX   WMEAN

01           3    0.009  0.020  0.013             3    0.009  0.009  0.009          1    0.010  0.010  0.010
02           3    0.009  0.010  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
03           2    0.009  0.010  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
11           3    0.009  0.009  0.009             3    0.009  0.009  0.009          1    0.009  0.009  0.009
15           3    0.009  0.020  0.013             3    0.009  0.009  0.009          1    0.003  0.003  0.003
19           4    0.009  0.020  0.012             5    0.009  0.009  0.009          1    0.004  0.004  0.004
25           3    0.009  0.009  0.009             3    0.009  0.009  0.009          1    0.004  0.004  0.004
27           7    0.009  0.010  0.009             7    0.009  0.010  0.009          1    0.004  0.004  0.004
29           2    0.009  0.040  0.024             2    0.009  0.009  0.009          .      .      .      .
32           2    0.009  0.010  0.009             2    0.009  0.009  0.009          .      .      .      .
33           1    0.009  0.009  0.009             2    0.009  0.009  0.009          .      .      .      .
36           0      .      .      .               0      .      .      .            1    0.009  0.009  0.009
42           1    0.009  0.009  0.009             0      .      .      .            0      .      .      .
44A          1    0.020  0.020  0.020             0      .      .      .            0      .      .      .
44B          0      .      .      .               0      .      .      .            0      .      .      .
46           2    0.009  0.027  0.018             2    0.009  0.009  0.009          0      .      .      .
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TABLE A4.42 Zinc, Total (mg/L)

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                                                   SAS
                     ZN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                      13:24 THURSDAY, JULY 12, 1984    7
                                                1970-1982

STATION    SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN      WMIN   WMAX   WMEAN

01          3    0.004  0.068  0.035          3    0.013  0.500  0.194         1     0.110  0.110  0.110
05          3    0.005  0.033  0.020          3    0.019  0.082  0.040         1     0.046  0.046  0.046
09          2    0.026  0.027  0.026          3    0.013  0.230  0.091         1     0.067  0.067  0.067
11          3    0.008  0.014  0.011          3    0.016  0.028  0.022         1     0.360  0.360  0.360
15          3    0.024  0.085  0.049          3    0.019  0.120  0.069         1     0.005  0.005  0.005
19          4    0.023  0.510  0.149          5    0.012  0.670  0.158         1     0.012  0.012  0.012
25          3    0.005  0.036  0.021          3    0.021  0.065  0.037         1     0.012  0.012  0.012
27         15    0.005  0.360  0.090         10    0.005  0.240  0.043         7     0.009  0.150  0.063
29          2    0.030  0.087  0.059          2    0.021  0.027  0.024         0       .      .      .
32          2    0.026  0.030  0.028          2    0.007  0.009  0.008         0       .      .      .
33          1    0.047  0.047  0.047          2    0.012  0.026  0.019         .       .      .      .
36          0      .      .      .            1    0.001  0.001  0.001         1     0.069  0.069  0.069
42          1    0.056  0.056  0.056          1    0.090  0.090  0.090         0       .      .      .
44N         1    0.022  0.022  0.022          0      .      .      .           0       .      .      .
44S         0      .      .      .            0      .      .      .           0       .      .      .
46         10    0.009  0.090  0.045          4    0.008  0.090  0.035         2     0.052  0.150  0.101
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                                                      SAS
                     ZN SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER                      8:58 MONDAY, JULY 16, 1984    4
                                       1981-1982

STATION    SN     SMIN   SMAX   SMEAN        FN     FMIN   FMAX   FMEAN        WN      WMIN   WMAX   WMEAN

01          3    0.004  0.068  0.036          3    0.013  0.500  0.184         1     0.110  0.110  0.110
05          3    0.005  0.033  0.020          3    0.019  0.082  0.040         1     0.046  0.046  0.046
09          2    0.026  0.027  0.026          3    0.013  0.230  0.091         1     0.067  0.067  0.067
11          3    0.008  0.014  0.011          3    0.016  0.028  0.022         1     0.360  0.360  0.360
15          3    0.024  0.085  0.049          3    0.019  0.120  0.069         1     0.005  0.005  0.005
19          4    0.023  0.510  0.149          5    0.012  0.670  0.158         1     0.012  0.012  0.012
25          3    0.005  0.036  0.021          3    0.021  0.065  0.037         1     0.012  0.012  0.012
27         10    0.005  0.310  0.051          8    0.005  0.240  0.048         4     0.012  0.130  0.046
29          2    0.030  0.087  0.059          2    0.021  0.027  0.024         .       .      .      .
32          2    0.026  0.030  0.028          2    0.007  0.009  0.008         .       .      .      .
33          1    0.047  0.047  0.047          2    0.012  0.026  0.019         .       .      .      .
36          0      .      .      .            0      .      .      .           1     0.069  0.069  0.069
42          1    0.056  0.056  0.056          0      .      .      .           0       .      .      .
44N         1    0.022  0.022  0.022          0      .      .      .           0       .      .      .
44S         0      .      .      .            0      .      .      .           0       .      .      .
46          5    0.023  0.062  0.042          2    0.008  0.036  0.022         2     0.052  0.150  0.101
```

TABLE A4.43 2,4-D (ug/L)

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                                                     SAS                                     8:35 MONDAY, JULY 16, 1984   10
                  TWOFOURD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1970-1982

STATION   SN    SMIN   SMAX   SMEAN        FN   FMIN   FMAX   FMEAN        WN   WMIN   WMAX   WMEAN

01         2   0.030  0.300  0.165         2   0.010  0.100  0.055         1   0.100  0.100  0.100
05         2   0.004  0.100  0.052         1   0.100  0.100  0.100         1   0.099  0.099  0.099
09         1   0.030  0.030  0.030         1   0.100  0.100  0.100         1   0.070  0.070  0.070
11         2   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.004  0.004  0.004
15         2   0.004  0.020  0.012         1   0.200  0.200  0.200         1   0.004  0.004  0.004
19         2   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.004  0.004  0.004
25         3   0.004  0.060  0.023         1   0.004  0.004  0.004         1   0.004  0.004  0.004
27         6   0.004  0.020  0.009         5   0.010  0.300  0.162         5   0.004  0.400  0.161
29         0     .      .      .           0     .      .      .           0     .      .      .
32         0     .      .      .           0     .      .      .           0     .      .      .
33         0     .      .      .           0     .      .      .           .     .      .      .
34         0     .      .      .           0     .      .      .           0     .      .      .
42         0     .      .      .           0     .      .      .           0     .      .      .
44N        0     .      .      .           0     .      .      .           0     .      .      .
44S        0     .      .      .           0     .      .      .           0     .      .      .
46         3   0.004  0.100  0.036         3   0.004  0.490  0.166         1   0.300  0.300  0.300
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                                                     SAS                                     8:46 MONDAY, JULY 16, 1984   10
                  TWOFOURD SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                         1981-1982

STATION   SN    SMIN   SMAX   SMEAN        FN   FMIN   FMAX   FMEAN        WN   WMIN   WMAX   WMEAN

01         2   0.030  0.300  0.165         2   0.010  0.100  0.055         1   0.100  0.100  0.100
05         2   0.004  0.100  0.052         1   0.100  0.100  0.100         1   0.099  0.099  0.099
09         1   0.030  0.030  0.030         1   0.100  0.100  0.100         1   0.070  0.070  0.070
11         2   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.004  0.004  0.004
15         2   0.004  0.020  0.012         1   0.200  0.200  0.200         1   0.004  0.004  0.004
19         2   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.004  0.004  0.004
25         2   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.004  0.004  0.004
27         5   0.004  0.020  0.007         4   0.010  0.200  0.127         4   0.004  0.300  0.101
29         0     .      .      .           0     .      .      .           .     .      .      .
32         0     .      .      .           0     .      .      .           .     .      .      .
33         0     .      .      .           0     .      .      .           .     .      .      .
34         0     .      .      .           0     .      .      .           0     .      .      .
42         0     .      .      .           0     .      .      .           0     .      .      .
44N        0     .      .      .           0     .      .      .           0     .      .      .
44S        0     .      .      .           0     .      .      .           0     .      .      .
46         1   0.004  0.004  0.004         1   0.004  0.004  0.004         1   0.300  0.300  0.300
```

TABLE A4.44 Gamma BHC (lindane)(ug/L)

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                                                  SAS                                             8:35 MONDAY, JULY 16, 1984   12
                         LINDANE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                              1970-1982

STATION    SN    SMIN   SMAX   SMEAN       FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01          2    0.001  0.010  0.005        1    0.001  0.001  0.001         1    0.001  0.001  0.001
02          1    0.001  0.002  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
03          1    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
11          2    0.001  0.003  0.002        1    0.001  0.001  0.001         1    0.001  0.001  0.001
15          2    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
17          2    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
25          3    0.001  0.002  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
27          6    0.001  0.008  0.002        4    0.001  0.001  0.001         4    0.001  0.001  0.001
29          0      .      .      .          0      .      .      .           0      .      .      .
32          0      .      .      .          0      .      .      .           0      .      .      .
33          0      .      .      .          0      .      .      .           .      .      .      .
36          0      .      .      .          0      .      .      .           0      .      .      .
42          0      .      .      .          0      .      .      .           0      .      .      .
44N         0      .      .      .          0      .      .      .           0      .      .      .
44S         0      .      .      .          0      .      .      .           0      .      .      .
46          3    0.001  0.001  0.001        2    0.001  0.001  0.001         1    0.001  0.001  0.001


                                                  SAS                                             9:46 MONDAY, JULY 16, 1984   12
                         LINDANE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
                                              1981-1982

STATION    SN    SMIN   SMAX   SMEAN       FN    FMIN   FMAX   FMEAN        WN    WMIN   WMAX   WMEAN

01          2    0.001  0.010  0.005        1    0.001  0.001  0.001         1    0.001  0.001  0.001
02          1    0.001  0.002  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
03          1    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
11          2    0.001  0.003  0.002        1    0.001  0.001  0.001         1    0.001  0.001  0.001
15          2    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
17          2    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
25          2    0.001  0.002  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
27          3    0.001  0.008  0.002        3    0.001  0.001  0.001         3    0.001  0.001  0.001
29          0      .      .      .          0      .      .      .           .      .      .      .
32          0      .      .      .          0      .      .      .           .      .      .      .
33          0      .      .      .          0      .      .      .           .      .      .      .
35          0      .      .      .          0      .      .      .           0      .      .      .
42          0      .      .      .          0      .      .      .           0      .      .      .
44N         0      .      .      .          0      .      .      .           0      .      .      .
44S         0      .      .      .          0      .      .      .           0      .      .      .
46          1    0.001  0.001  0.001        1    0.001  0.001  0.001         1    0.001  0.001  0.001
```

TABLE A4.45 Alpha BHC (ug/L)

8:35 MONDAY, JULY 16, 1984 11

SAS

ALPHABHC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	2	0.005	0.010	0.007	1	0.007	0.007	0.007	1	0.003	0.003	0.003
05	2	0.002	0.005	0.003	1	0.007	0.007	0.007	1	0.004	0.004	0.004
09	1	0.001	0.001	0.001	1	0.004	0.004	0.004	1	0.004	0.004	0.004
11	2	0.002	0.005	0.003	1	0.005	0.005	0.005	1	0.003	0.003	0.003
15	2	0.001	0.005	0.003	1	0.001	0.001	0.001	1	0.004	0.004	0.004
19	2	0.002	0.002	0.002	1	0.005	0.005	0.005	1	0.004	0.004	0.004
25	3	0.002	0.003	0.002	1	0.005	0.005	0.005	1	0.004	0.004	0.004
27	6	0.001	0.010	0.003	4	0.003	0.005	0.003	4	0.001	0.004	0.003
29	0	.	.	.	0	.	.	.	0	.	.	.
32	0	.	.	.	0	.	.	.	0	.	.	.
33	0	.	.	.	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	0	.	.	.	0	.	.	.	0	.	.	.
44N	0	.	.	.	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	3	0.002	0.020	0.010	2	0.004	0.006	0.005	1	0.003	0.003	0.003

9:46 MONDAY, JULY 16, 1984 11

SAS

ALPHABHC SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	2	0.005	0.010	0.007	1	0.007	0.007	0.007	1	0.003	0.003	0.003
05	2	0.002	0.005	0.003	1	0.007	0.007	0.007	1	0.004	0.004	0.004
09	1	0.001	0.001	0.001	1	0.004	0.004	0.004	1	0.004	0.004	0.004
11	2	0.002	0.005	0.003	1	0.005	0.005	0.005	1	0.003	0.003	0.003
15	2	0.001	0.005	0.003	1	0.001	0.001	0.001	1	0.004	0.004	0.004
19	2	0.002	0.002	0.002	1	0.005	0.005	0.005	1	0.004	0.004	0.004
25	2	0.002	0.003	0.002	1	0.005	0.005	0.005	1	0.004	0.004	0.004
27	5	0.001	0.010	0.003	3	0.003	0.005	0.004	3	0.004	0.004	0.004
29	0	.	.	.	0	.	.	.	.	.	.	.
32	0	.	.	.	0	.	.	.	.	.	.	.
33	0	.	.	.	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	0	.	.	.	0	.	.	.	0	.	.	.
44N	0	.	.	.	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	1	0.002	0.002	0.002	1	0.005	0.006	0.006	1	0.003	0.003	0.003

TABLE A4.46 Phenolics (ug/L)

PHENOLS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

8:08 FRIDAY, SEPTEMBER 28, 1984

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	3.000	5.000	3.667	2	4.000	5.000	4.500	1	13.000	13.000	13.000
05	3	2.000	5.000	3.000	3	1.000	5.000	2.667	1	2.000	2.000	2.000
08	2	1.000	2.500	1.750	3	3.000	4.000	3.333	1	5.000	5.000	5.000
11	3	2.000	9.000	5.667	3	2.000	8.000	4.667	1	0.490	0.490	0.490
15	3	3.000	4.000	3.667	2	2.000	4.000	3.000	2	2.500	4.000	3.250
19	4	2.000	9.000	5.250	5	2.000	4.000	3.200	1	7.000	7.000	7.000
25	3	3.000	4.000	3.667	3	2.000	9.000	4.667	1	9.000	9.000	9.000
27	4	2.000	8.000	4.000	5	2.000	9.000	4.600	2	1.000	2.000	1.500
29	3	1.300	3.000	2.433	2	2.000	2.000	2.000	0	.	.	.
32	2	2.000	3.000	2.500	2	1.000	2.000	1.500	0	.	.	.
33	1	1.000	1.000	1.000	2	1.000	4.000	2.500	.	.	.	.
36	0	.	.	.	1	6.000	6.000	6.000	0	.	.	.
42	1	3.000	3.000	3.000	0	.	.	.	0	.	.	.
44N	1	6.000	6.000	6.000	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	2.000	6.000	4.000	2	3.000	6.000	4.500	0	.	.	.

SAS
PHENOLS SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

9:24 FRIDAY, SEPTEMBER 28, 1984

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	3.000	5.000	3.667	2	4.000	5.000	4.500	1	13.000	13.000	13.000
05	3	2.000	5.000	3.000	3	1.000	5.000	2.667	1	2.000	2.000	2.000
08	2	1.000	2.500	1.750	3	3.000	4.000	3.333	1	5.000	5.000	5.000
11	3	2.000	9.000	5.667	3	2.000	8.000	4.667	1	0.490	0.490	0.490
15	3	3.000	4.000	3.667	2	2.000	4.000	3.000	1	4.000	4.000	4.000
19	4	2.000	9.000	5.250	5	2.000	4.000	3.200	1	7.000	7.000	7.000
25	3	3.000	4.000	3.667	3	2.000	9.000	4.667	1	9.000	9.000	9.000
27	4	2.000	8.000	4.000	5	2.000	9.000	4.600	1	1.000	1.000	1.000
29	2	3.000	3.000	3.000	2	2.000	2.000	2.000	.	.	.	.
32	2	2.000	3.000	2.500	2	1.000	2.000	1.500	.	.	.	.
33	1	1.000	1.000	1.000	2	1.000	4.000	2.500	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	1	3.000	3.000	3.000	0	.	.	.	0	.	.	.
44N	1	6.000	6.000	6.000	0	.	.	.	0	.	.	.
44S	0	.	.	.	0	.	.	.	0	.	.	.
46	2	2.000	6.000	4.000	2	3.000	6.000	4.500	0	.	.	.

TABLE A4.47 Resin Acids (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

RA SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.049	0.110	0.083	3	0.049	0.049	0.049	1	0.049	0.049	0.049
05	3	0.070	0.150	0.103	1	0.049	0.049	0.049	2	0.049	0.800	0.424
08	2	0.070	0.120	0.095	1	0.049	0.049	0.049	1	0.049	0.049	0.049
11	3	0.049	0.310	0.150	1	0.049	0.049	0.049	1	0.049	0.049	0.049
15	3	0.090	0.180	0.137	1	1.500	1.500	1.500	1	0.049	0.049	0.049
19	4	0.060	0.250	0.135	1	1.400	1.400	1.400	1	0.049	0.049	0.049
25	3	0.060	11.000	3.717	1	2.200	2.200	2.200	1	6.000	6.000	6.000
27	7	0.049	0.160	0.085	10	0.049	8.900	1.039	3	0.049	0.090	0.070
29	2	0.150	0.160	0.155	2	0.049	0.049	0.049	0	.	.	.
32	2	0.130	0.150	0.140	2	0.049	0.049	0.049	0	.	.	.
33	7	0.049	0.120	0.078	2	0.049	0.049	0.049	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	21	0.049	1.100	0.250	13	0.049	0.360	0.131	6	0.049	0.290	0.135
44N	17	0.049	0.700	0.283	15	0.049	6.300	0.607	15	0.049	1.000	0.325
44S	2	0.049	0.080	0.064	0	.	.	.	1	0.049	0.049	0.049
46	20	0.019	1.000	0.273	15	0.049	1.900	0.246	5	0.049	0.550	0.240

9:24 FRIDAY, SEPTEMBER 28, 1984

RA SUMMARY GOING DOWNSTREAM OF THE SAS N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
C1	3	0.049	0.110	0.083	3	0.049	0.049	0.049	1	0.049	0.049	0.049
C5	3	0.070	0.150	0.103	1	0.049	0.049	0.049	1	0.049	0.049	0.049
08	2	0.070	0.120	0.095	1	0.049	0.049	0.049	1	0.049	0.049	0.049
11	3	0.049	0.310	0.150	1	0.049	0.049	0.049	1	0.049	0.049	0.049
15	3	0.090	0.180	0.137	1	1.500	1.500	1.500	1	0.049	0.049	0.049
19	4	0.060	0.250	0.135	1	1.400	1.400	1.400	1	0.049	0.049	0.049
25	3	0.060	11.000	3.717	1	2.200	2.200	2.200	1	6.000	6.000	6.000
27	7	0.049	0.160	0.085	10	0.049	8.900	1.039	3	0.049	0.090	0.070
29	2	0.150	0.160	0.155	2	0.049	0.049	0.049	.	.	.	.
32	2	0.130	0.150	0.140	2	0.049	0.049	0.049	.	.	.	.
33	7	0.049	0.120	0.078	2	0.049	0.049	0.049	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	9	0.049	0.310	0.094	4	0.049	0.090	0.059	6	0.049	0.290	0.135
44N	7	0.049	0.680	0.173	4	0.049	6.300	1.622	7	0.049	0.750	0.225
44S	2	0.049	0.080	0.064	0	.	.	.	1	0.049	0.049	0.049
46	11	0.019	0.670	0.154	6	0.049	1.900	0.379	3	0.049	0.550	0.216

TABLE A4.48 Sulphide (mg/L)

8:08 FRIDAY, SEPTEMBER 28, 1984

SULPHIDE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1970-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.009	0.220	0.083	0	.	.	.	1	0.030	0.030	0.030
05	3	0.009	0.140	0.056	0	.	.	.	2	0.009	0.009	0.009
08	2	0.100	0.700	0.400	0	.	.	.	1	0.009	0.009	0.009
11	3	0.009	0.100	0.043	0	.	.	.	1	0.009	0.009	0.009
15	3	0.009	0.050	0.026	0	.	.	.	1	0.009	0.009	0.009
19	4	0.009	0.140	0.062	0	.	.	.	1	0.009	0.009	0.009
25	3	0.009	0.049	0.026	0	.	.	.	1	0.020	0.020	0.020
27	7	0.009	0.960	0.245	5	0.009	1.900	0.387	3	0.009	0.010	0.009
29	2	0.009	0.009	0.009	0	.	.	.	0	.	.	.
32	2	0.009	0.009	0.009	0	.	.	.	0	.	.	.
33	7	0.009	0.480	0.168	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	1	0.019	0.019	0.019
42	21	0.009	0.310	0.044	12	0.009	0.019	0.012	9	0.009	0.019	0.015
44N	18	0.009	0.350	0.069	16	0.009	3.200	0.258	22	0.009	0.150	0.050
44S	2	0.009	0.300	0.154	0	.	.	.	0	.	.	.
46	18	0.009	0.680	0.069	12	0.009	0.090	0.021	9	0.009	0.030	0.015

9:24 FRIDAY, SEPTEMBER 28, 1984

SAS

SULPHIDE SUMMARY GOING DOWNSTREAM OF THE N.SASK.RIVER
1981-1982

STATION	SN	SMIN	SMAX	SMEAN	FN	FMIN	FMAX	FMEAN	WN	WMIN	WMAX	WMEAN
01	3	0.009	0.220	0.083	0	.	.	.	1	0.030	0.030	0.030
05	3	0.009	0.140	0.056	0	.	.	.	1	0.009	0.009	0.009
08	2	0.100	0.700	0.400	0	.	.	.	1	0.009	0.009	0.009
11	3	0.009	0.100	0.043	0	.	.	.	1	0.009	0.009	0.009
15	3	0.009	0.050	0.026	0	.	.	.	1	0.009	0.009	0.009
19	4	0.009	0.140	0.062	0	.	.	.	1	0.009	0.009	0.009
25	3	0.009	0.049	0.026	0	.	.	.	1	0.020	0.020	0.020
·27	7	0.009	0.960	0.245	5	0.009	1.900	0.387	3	0.009	0.010	0.009
29	2	0.009	0.009	0.009	0	.	.	.	.	.	.	.
32	2	0.009	0.009	0.009	0	.	.	.	.	.	.	.
·33	7	0.009	0.460	0.168	0	.	.	.	.	.	.	.
36	0	.	.	.	0	.	.	.	0	.	.	.
42	9	0.009	0.310	0.042	3	0.009	0.010	0.009	5	0.009	0.019	0.011
·44N	6	0.009	0.230	0.049	4	0.019	3.200	0.822	7	0.009	0.030	0.013
44S	2	0.009	0.300	0.154	0	.	.	.	0	.	.	.
·46	10	0.009	0.680	0.104	4	0.009	0.019	0.011	5	0.009	0.019	0.011

APPENDIX 5

ANNUAL MEAN VALUES FOR WATER QUALITY VARIABLES AT STATIONS ALONG THE NORTH SASKATCHEWAN RIVER BETWEEN 1970 AND 1982

TAPLE A5.1

NORTH SASK RIVER

ANNUAL MEANS

Lloydminster Ferry (STA 01)

PARAMETER		71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	6.2	8.766	10.2	10.571	11.05	8.5	10.55	9.6	.	9.9	10.555	9.57
SAT	%	46	54.333	101.866	84.285	98.5	62.5	81.5	73	100	90.8	95.2	91.555
TOC	MG/L	.	.	.	10.666	7.5	3	6.5	1	0.9	11.75	10.4	4.304
BOD	MG/L	0.2	2	2.14	2.122	4.75	2.4	1.3	1	1.2	0.95	2.333	2.496
TKN	MG/L	.	1.225	2.32	1.066	0.8	1.6	0.4	0.6	0.8	0.75	0.62	0.826
NO3N	MG/L	.	0.335	0.289	0.317	0.295	0.5	0.365	0.54	0.04	0.28	0.144	0.249
NH3N	MG/L	1.17	0.637	0.326	0.505	0.18	0.88	0.125	0.4	0.45	0.074	0.060	0.089
TP	MG/L	0.11	0.054	0.076	0.028	0.055	0.036	0.138	0.13	0.13	0.245	0.149	0.196
DP	MG/L	0.11	0.039	0.042	0.024	0.009	0.009	0.0345	0.09	0.1	0.052	0.036	0.098
PH	UNITS	7.6	7.925	7.94	8.044	8.45	7.966	8.9	7.7	8	8	8.433	8.411
TALK	MG/L	169	161.75	147	135.625	137	134	133	122	156	139.5	124.133	141.444
COND	US/CM	475	347.5	370	298.888	350	350	275	300	320	287.8	292.6	332.777
THARD	MG/L	.	220	200	164	.	.	.	.	.	.	158.333	175.826
NA	MG/L	.	23	16	14	17	.	.	.	.	.	7.583	8.260
MG	MG/L	.	.	10	14.8	.	.	.	.	.	.	15.090	14.809
CA	MG/L	.	.	64	43	.	.	.	.	.	.	39.181	45.318
CL	MG/L	21	16.225	9	11.888	10	16	10	4	2	4.45	3.44	7.629
K	MG/L	.	.	.	.	.	.	.	.	.	.	1.416	1.608
SO4	MG/L	.	55.666	44.5	45.222	55.5	.	.	.	.	.	45.25	37
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	6.5	14
TSS	MG/L	.	13.875	21.9	60.777	34	15.666	10.5	12	3	236	110.533	84.037
TURB	NTU	.	.	.	.	.	.	.	.	.	.	94.4	47.666
AL	MG/L	.	.	.	.	.	.	.	.	.	.	0.405	2.776
AS	UG/L	.	.	.	.	.	.	.	.	.	.	0.595	1.475
BA	MG/L	.	.	.	.	.	.	.	.	.	.	0.0695	0.095
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.012
CD	MG/L	.	.	.	.	.	.	.	.	.	.	0.0004	0.0009
CR	MG/L	.	.	.	.	.	.	.	.	.	.	0.003	0.006
CO	MG/L	.	.	.	.	.	.	.	.	.	.	0.0009	0.001
CU	MG/L	.	.	.	.	.	.	.	.	.	.	0.011	0.012
PB	MG/L	.	.	.	.	.	.	.	.	.	.	0.001	0.007
HG	UG/L	.	.	.	.	.	.	.	.	.	.	0.15	0.019
MO	MG/L	.	.	.	.	.	.	.	.	.	.	0.004	0.004
NI	MG/L	.	.	.	.	.	.	.	.	.	.	0.004	0.010
SE	MG/L	.	.	.	.	.	.	.	.	.	.	0.0009	0.003
AG	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	0.009	0.011
ZN	MG/L	.	.	.	.	.	.	.	.	.	.	0.252	0.053
240	UG/L	.	.	.	.	.	.	.	.	.	.	0.065	0.136
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	0.005	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	0.008	0.004
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	.	4.5	6
CN	UG/L	.	.	.	.	.	.	.	.	.	.	2.05	0.316
RA	MG/L	.	.	.	.	.	.	.	.	.	.	0.069	0.061
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	.	0.019	0.086
TDS	MG/L	.	399	361	284.8	.	.	.	.	.	.	249.636	279.409

TABLE A5.2

NORTH SASK RIVER

ANNUAL MEANS

HIGHWAY 3 CROSSING (STA 05)

PARAMETER		71	73	74	75	76	77	78	79	80	81	82
							YEAR					
DO	MG/L	9.05	10.45	10.662	11.15	9.95	10.166	9.5	.	9.233	10.355	9.3
SAT	%	66.5	102.466	79.571	69	80.75	87	72	100	74.25	95.477	89.25
TOC	MG/L	.	.	12.444	5	5.725	9.6	4	2	8.75	10.8	2.57
BOD	MG/L	0.8	1.95	2.277	3.166	3.075	1.6	0.8	1.8	1.15	2.328	2.062
TKN	MG/L	1.7	1.15	0.866	1.375	1.4	0.54	0.6	0.9	0.65	0.566	0.853
NO3N	MG/L	0.57	0.309	0.316	0.27	0.292	0.308	0.54	0.34	0.365	0.178	0.314
NH3N	MG/L	1.045	0.22	0.37	0.365	0.61	0.087	0.32	0.38	0.137	0.057	0.106
TP	MG/L	0.13	0.065	0.036	0.037	0.032	0.208	0.11	0.16	0.145	0.167	0.224
DP	MG/L	0.125	0.011	0.024	0.012	0.01	0.0636	0.07	0.06	0.067	0.048	0.079
PH	UNITS	7.95	8.1	7.977	8.225	8.1	8.2	7.7	7.8	7.925	8.346	8.337
TALK	MG/L	184	149.75	137.555	135	137.5	126	124	160	139.5	122.866	136.812
COND	US/CM	500	362.5	322.222	312.5	337.5	290	300	340	325	298.2	333.062
THARD	MG/L	.	.	171.333	.	.	.	.	.	.	156.333	170.666
NA	MG/L	33	15.333	12.222	16	.	.	.	.	.	8.166	6.583
MG	MG/L	.	.	16.833	.	.	.	.	.	.	14.818	15
CA	MG/L	.	.	41.833	.	.	.	.	.	.	39.090	43.916
CL	MG/L	28	7	14.111	15.5	10.25	5.56	10	6	3.925	4.253	5.987
K	MG/L	.	.	.	.	.	.	.	.	.	1.416	1.666
SO4	MG/L	82	37	46.777	56.5	.	.	.	.	.	45.166	37.923
COLOR	UNITS	.	.	.	.	.	.	.	.	.	7	9.666
TSS	MG/L	2	17.625	29.055	55	14.5	48.6	12	63	155.75	130.733	121.187
TURB	NTU	.	.	.	.	.	.	.	.	.	94.86	63.25
AL	MG/L	.	.	.	.	.	.	.	.	.	0.57	1.232
AS	UG/L	.	.	.	.	.	.	.	.	.	0.645	1.55
BA	MG/L	.	.	.	.	.	.	.	.	.	0.044	0.077
B	MG/L	.	.	.	.	.	.	.	.	.	.	0.016
CD	MG/L	.	.	.	.	.	.	.	.	.	0.003	0.0007
CR	MG/L	.	.	.	.	.	.	.	.	.	0.002	0.006
CO	MG/L	.	.	.	.	.	.	.	.	.	0.0009	0.001
CU	MG/L	.	.	.	.	.	.	.	.	.	0.006	0.010
PB	MG/L	.	.	.	.	.	.	.	.	.	0.003	0.006
HG	UG/L	.	.	.	.	.	.	.	.	.	0.135	0.019
MO	MG/L	.	.	.	.	.	.	.	.	.	0.004	0.004
NI	MG/L	.	.	.	.	.	.	.	.	.	0.010	0.005
SE	MG/L	.	.	.	.	.	.	.	.	.	0.0009	0.003
AG	MG/L	.	.	.	.	.	.	.	.	.	.	0.0005
U	UG/L	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	0.009	[illegible]
ZN	MG/L	.	.	.	.	.	.	.	.	.	0.043	0.028
24D	UG/L	.	.	.	.	.	.	.	.	.	0.051	0.099
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	0.001	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	0.006	[illegible]
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	5	1.6
CN	UG/L	.	.	.	.	.	.	.	.	.	2.25	2.978
RA	MG/L	.	.	.	.	.	.	.	.	0.8	0.069	0.089
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	0.009	0.019	0.052
TDS	MG/L	.	.	285.666	.	.	.	.	.	.	251.454	272.083

TABLE A5.3
NORTH SASK RIVER
ANNUAL MEANS
HIGHWAY 21 CROSSING (STA 08)

PARAMETER		71	73	74	75	76	77	78	80	81	82
								YEAR			
DO	MG/L	9.25	10.566	11.033	14.1	8.3	11.25	8.5	9.2	10.033	10.088
SAT	%	67	111	107	.	62	86.5	64	75.3	92.366	93.666
TOC	MG/L	.	.	10.5	6	4	5.5	2	7.333	9.777	2.438
BOD	MG/L	0.8	3.033	3.14	2.2	2.45	1.2	0.6	1.24	1.575	2.262
TKN	MG/L	.	0.8	1.08	0.95	1.65	0.75	0.7	0.698	0.6	0.830
NO3N	MG/L	0.54	0.323	0.195	0.295	0.525	0.26	0.54	0.38	0.197	0.256
NH3N	MG/L	1.11	0.393	0.258	0.1	0.715	0.095	0.32	0.142	0.075	0.110
TP	MG/L	0.115	0.093	0.023	0.04	0.04	0.133	0.13	0.206	0.241	0.186
DP	MG/L	0.12	0.029	0.017	0.025	.	0.0345	0.07	0.061	0.058	0.075
PH	UNITS	7.9	8.1	8.32	8.35	7.95	8.35	7.6	7.916	8.111	8.356
TALK	MG/L	183	151.333	154.75	125	133	132	126	143	131	137.062
COND	US/CM	500	350	308	350	325	275	300	338.333	336.777	333.25
THARD	MG/L	.	212	168	.	.	.	.	.	152.666	173.666
NA	MG/L	33	17	13.8	17	.	.	.	.	7.166	6.416
MG	MG/L	.	21	16	.	.	.	.	.	11.833	15.363
CA	MG/L	.	50	42	.	.	.	.	.	42.166	43.272
CL	MG/L	30.5	12.666	10.8	12	12.5	10	12	5.316	3.966	5.475
K	MG/L	.	.	.	.	.	.	.	.	1.833	1.75
SO4	MG/L	75	45	51.2	53.5	.	.	.	.	40.666	39.818
COLOR	UNITS	.	.	.	.	.	.	.	.	4	9.666
TSS	MG/L	3	24.166	52.2	32	13.5	9	14	149	227.333	84.937
TURB	NTU	.	.	.	.	.	.	.	.	127.825	49.7
AL	MG/L	.	.	.	.	.	.	.	.	0.43	1.206
AS	UG/L	.	.	.	.	.	.	.	.	5.4	1
BA	MG/L	.	.	.	.	.	.	.	.	0.08	0.081
B	MG/L	.	.	.	.	.	.	.	.	.	0.013
CD	MG/L	.	.	.	.	.	.	.	.	0.0004	0.0007
CR	MG/L	.	.	.	.	.	.	.	.	0.003	0.005
CO	MG/L	.	.	.	.	.	.	.	.	0.0009	0.001
CU	MG/L	.	.	.	.	.	.	.	.	0.006	0.008
PB	MG/L	.	.	.	.	.	.	.	.	0.001	0.007
HG	UG/L	.	.	.	.	.	.	.	.	0.03	0.019
MO	MG/L	.	.	.	.	.	.	.	.	0.004	0.004
NI	MG/L	.	.	.	.	.	.	.	.	0.002	0.006
SE	MG/L	.	.	.	.	.	.	.	.	0.0009	0.003
AG	MG/L	.	.	.	.	.	.	.	.	.	0.001
U	UG/L	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	0.009	0.009
ZN	MG/L	.	.	.	.	.	.	.	.	0.23	0.032
24D	UG/L	.	.	.	.	.	.	.	.	0.1	0.05
LINDANE	UG/L	.	.	.	.	.	.	.	.	0.0009	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	0.0041	0.002
PHENOLS	UG/L	.	.	.	.	.	.	.	.	3	3.1
CN	UG/L	.	.	.	.	.	.	.	.	1.5	0.336
RA	MG/L	.	.	.	.	.	.	.	.	0.049	0.079
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	0.269
TDS	MG/L	.	380	287	.	.	.	.	.	259.6	272.6

TABLE A5.4
NORTH SASK RIVER
ANNUAL MEANS
PAYNTON FERRY (STA 11)
YEAR

PARAMETER		81	82
DO	MG/L	10.883	10
SAT	%	96.333	96.5
TOC	MG/L	11.583	3.391
BOD	MG/L	1.35	2.455
TKN	MG/L	0.575	0.82
NO3N	MG/L	0.106	0.183
NH3N	MG/L	0.055	0.129
TP	MG/L	0.233	0.153
DP	MG/L	0.030	0.06
PH	UNITS	8.3	8.455
TALK	MG/L	132.416	135.055
COND	US/CM	301.166	336.333
THARD	MG/L	178.333	170.857
NA	MG/L	7.916	6.312
MG	MG/L	17	15.230
CA	MG/L	43.5	48.692
CL	MG/L	3.141	5.433
K	MG/L	1.416	1.875
SO4	MG/L	44.833	42
COLOR	UNITS	6	10.333
TSS	MG/L	22.545	74.888
TURB	NTU	106.28	38.533
AL	MG/L	0.695	1.785
AS	UG/L	0.65	1.125
BA	MG/L	0.042	0.065
B	MG/L	.	0.012
CD	MG/L	0.019	0.0007
CR	MG/L	0.003	0.004
CO	MG/L	0.0009	0.001
CU	MG/L	0.010	0.007
PB	MG/L	0.002	0.004
HG	UG/L	0.155	0.025
MO	MG/L	0.0049	0.004
NI	MG/L	0.005	0.026
SE	MG/L	0.0009	0.003
AG	MG/L	.	0.0009
U	UG/L	.	0.009
V	MG/L	0.009	0.009
ZN	MG/L	0.018	0.0846
24D	UG/L	0.003	0.003
LINDANE	UG/L	0.001	0.0009
ALPHABHC	UG/L	0.005	0.002
PHENOLS	UG/L	6.5	3.698
CN	UG/L	3.75	0.356
RA	MG/L	0.069	0.136
SULPHIDE	MG/L	0.019	0.039
TDS	MG/L	274.75	271.9

TABLE A5.5

NORTH SASK RIVER

ANNUAL MEANS

HIGHWAY 16 CROSSING (STA 15)

PARAMETER		YEAR 71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	8.725	7.4	10.475	11.9	9.933	9.8	11.75	8.533	.	7.8	7.485	9.91
SAT	%	73.75	68	94.6	113.5	90.333	79	113	72.666	104	60	73.442	93.3
TOC	MG/L	.	.	.	11	9.25	4.75	10	2.633	.	8.5	9.235	4.414
BOD	MG/L	1	14.233	2.375	2.35	3.78	2.1	2.8	0.9	4.4	1.15	1.952	2.322
TKN	MG/L	.	0.91	1.075	1.66	1.28	1.675	0.7	0.566	1.3	0.625	0.788	0.773
NO3N	MG/L	0.324	0.26	0.292	0.193	0.234	0.374	0.105	0.253	0.03	0.322	0.402	0.185
NH3N	MG/L	0.737	0.57	0.325	0.148	0.296	0.595	0.03	0.136	0.03	0.107	0.042	0.088
TP	MG/L	0.062	0.07	0.05	0.03	0.036	0.037	0.155	0.133	0.19	0.142	0.292	0.152
DP	MG/L	0.047	1.83	0.017	0.009	0.014	0.009	0.03	0.046	0.04	0.047	0.052	0.049
PH	UNITS	7.875	7.766	7.9	8.16	8.3	8.125	8.5	8	7.8	8.175	7.994	8.5
TALK	MG/L	207.5	251.333	140	201.4	151.2	140.5	145	136.6667	136	144	141.352	140.055
COND	US/CM	403.75	600	400	360	390	337.5	275	300	400	337.5	393.882	348.666
THARD	MG/L	.	224	202	180	.	.	.	.	.	.	168	176.285
NA	MG/L	36	113	15.666	14.25	38	.	.	.	.	.	7.692	7.571
MG	MG/L	.	.	15	18	.	.	.	.	.	.	14.25	15.692
CA	MG/L	.	.	56	42	.	.	.	.	.	.	43.833	44.307
CL	MG/L	21	59.666	15.75	15.2	13.4	10.75	9	6.633	6	4.45	4.570	4.755
K	MG/L	.	.	.	.	.	.	.	.	.	.	2.230	1.857
SO4	MG/L	75	199.5	48	53.5	90	.	.	.	.	.	46.692	42.066
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	9.5	10.333
TSS	MG/L	5	74.333	21.25	22.375	56	28	57	53.333	33	91.25	335.882	68.388
TURB	NTU	.	.	.	.	.	.	.	.	.	.	131.425	32.966
AL	MG/L	.	.	.	.	.	.	.	.	.	.	4.585	0.906
AS	UG/L	.	.	.	.	.	.	.	.	.	.	2.045	0.95
BA	MG/L	.	.	.	.	.	.	.	.	.	.	0.13	0.052
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.017
CD	MG/L	.	.	.	.	.	.	.	.	.	.	0.0004	0.001
CR	MG/L	.	.	.	.	.	.	.	.	.	.	0.011	0.006
CO	MG/L	.	.	.	.	.	.	.	.	.	.	0.002	0.001
CU	MG/L	.	.	.	.	.	.	.	.	.	.	0.012	0.012
PB	MG/L	.	.	.	.	.	.	.	.	.	.	0.012	0.008
HG	UG/L	.	.	.	.	.	.	.	.	.	.	0.129	0.019
MO	MG/L	.	.	.	.	.	.	.	.	.	.	0.005	0.004
NI	MG/L	.	.	.	.	.	.	.	.	.	.	0.009	0.011
SE	MG/L	.	.	.	.	.	.	.	.	.	.	0.0009	0.003
AG	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	0.0145	0.008
ZN	MG/L	.	.	.	.	.	.	.	.	.	.	0.079	0.04
24D	UG/L	.	.	.	.	.	.	.	.	.	.	0.101	0.011
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	0.0009	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	0.003	0.002
PHENOLS	UG/L	2.5	.	.	.	.	.	.	.	.	.	4	3.25
CN	UG/L	.	.	.	.	.	.	.	.	.	.	3.75	4.438
RA	MG/L	.	.	.	.	.	.	.	.	.	.	0.795	0.123
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	.	0.019	0.022
TDS	MG/L	.	412	358	297	.	.	.	.	.	.	287.75	275.769

TABLE A5.6

NORTH SASK RIVER
ANNUAL MEANS
OLD HIGHWAY 4 CROSSING (STA 19)
YEAR

PARAMETER		81	82
DO	MG/L	7.78	10.314
SAT	%	76.78	101.285
TOC	MG/L	9.846	3.933
BOD	MG/L	2.215	2.8
TKN	MG/L	0.861	0.805
NO3N	MG/L	0.384	0.165
NH3N	MG/L	0.044	0.076
TP	MG/L	0.363	0.151
DP	MG/L	0.042	0.043
PH	UNITS	8.084	8.531
TALK	MG/L	137.461	134.681
COND	US/CM	331.692	355.272
THARD	MG/L	168	175.454
NA	MG/L	12.692	7.590
MG	MG/L	14.7	15.047
CA	MG/L	43.3	44.772
CL	MG/L	3.076	4.35
K	MG/L	2.076	1.863
SO4	MG/L	46.846	46.363
COLOR	UNITS	11	10.75
TSS	MG/L	429.846	73.318
TURB	NTU	97.6	26.7
AL	MG/L	3.7	1.076
AS	UG/L	2.345	0.915
BA	MG/L	0.14	0.069
B	MG/L	.	0.018
CD	MG/L	0.0004	0.0007
CR	MG/L	0.011	0.010
CO	MG/L	0.002	0.001
CU	MG/L	0.013	0.042
PB	MG/L	0.017	0.008
HG	UG/L	0.11	0.033
MO	MG/L	0.004	0.004
NI	MG/L	0.025	0.013
SE	MG/L	0.001	0.002
AG	MG/L	.	0.001
U	UG/L	.	0.009
V	MG/L	0.014	0.008
ZN	MG/L	0.354	0.085
24D	UG/L	0.003	0.003
LINDANE	UG/L	0.0009	0.0009
ALPHABHC	UG/L	0.003	0.003
PHENOLS	UG/L	5	4.25
CN	UG/L	2.2	1.748
RA	MG/L	0.745	0.124
SULPHIDE	MG/L	0.019	0.059
TDS	MG/L	286.692	282.454

TABLE A5.7

NORTH SASK RIVER

ANNUAL MEANS

HIGHWAY 376 CROSSING (STA 25)

PARAMETER		71	73	74	75	76	77	78	79	80	81	82
								YEAR				
DO	MG/L	8.9	10.65	11.55	9.25	8.2	11.05	8.7	.	9.066	7.6	9.47
SAT	%	64.5	.	115.5	83	60	86.5	67	.	69.3	74.4	91.7
TOC	MG/L	.	.	15.375	8	6	7.333	0.9	.	9	8.785	2.628
BOD	MG/L	1.35	1.05	2.75	3.2	1.7	1.133	0.6	.	1.6	2.276	2.262
TKN	MG/L	.	1.05	1.2	1.65	1.65	0.3	0.4	.	0.7	0.692	0.846
NO3N	MG/L	0.63	0.35	0.192	0.295	0.495	0.206	0.54	.	0.227	0.191	0.179
NH3N	MG/L	0.605	0.355	0.212	0.145	0.715	0.103	0.25	.	0.117	0.054	0.107
TP	MG/L	0.08	0.06	0.025	0.03	0.04	0.106	0.11	.	0.2	0.264	0.223
DP	MG/L	0.065	0.0145	0.009	0.01	.	0.024	0.06	.	0.075	0.039	0.062
PH	UNITS	7.9	7.95	8.2	8.05	8	8.266	7.6	.	8.075	8.164	8.411
TALK	MG/L	188.5	154	160.25	133	150	141.333	134	.	149.5	139.785	146.388
COND	US/CM	500	375	350	375	350	300	300	.	335	338.571	367
THARD	MG/L	.	200	192	.	.	.	.	.	.	165.090	182.857
NA	MG/L	34	18.5	19.25	21	.	.	.	.	.	8.818	10.214
MG	MG/L	.	16	19	.	.	.	.	.	.	13.454	16.076
CA	MG/L	.	54	45	.	.	.	.	.	.	44.363	45
CL	MG/L	30.5	8.5	11	12	12.5	12.666	6	.	4.475	4.414	6.322
K	MG/L	.	.	.	.	.	.	.	.	.	2.181	2.384
SO4	MG/L	78	51.5	52.5	59	.	.	.	.	.	47	48.071
COLOR	UNITS	.	.	.	.	.	.	.	.	.	6	7.349
TSS	MG/L	4	16.25	35.125	36	7	13	9	.	89.5	224.857	69
TURB	NTU	.	.	.	.	.	.	.	.	.	77	31
AL	MG/L	.	.	.	.	.	.	.	.	.	0.955	1.868
AS	UG/L	.	.	.	.	.	.	.	.	.	0.945	0.95
BA	MG/L	.	.	.	.	.	.	.	.	.	0.088	0.082
B	MG/L	.	.	.	.	.	.	.	.	.	.	0.022
CD	MG/L	.	.	.	.	.	.	.	.	.	0.0004	0.0007
CR	MG/L	.	.	.	.	.	.	.	.	.	0.005	0.0125
CO	MG/L	.	.	.	.	.	.	.	.	.	0.0009	0.001
CU	MG/L	.	.	.	.	.	.	.	.	.	0.010	0.016
PB	MG/L	.	.	.	.	.	.	.	.	.	0.007	0.009
HG	UG/L	.	.	.	.	.	.	.	.	.	0.144	0.023
MO	MG/L	.	.	.	.	.	.	.	.	.	0.004	0.004
NI	MG/L	.	.	.	.	.	.	.	.	.	0.006	0.028
SE	MG/L	.	.	.	.	.	.	.	.	.	0.001	0.003
AG	MG/L	.	.	.	.	.	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	0.009	0.008
ZN	MG/L	.	.	.	.	.	.	.	.	.	0.03	0.025
24D	UG/L	.	.	.	.	.	.	.	0.06	.	0.003	0.003
LINDANE	UG/L	.	.	.	.	.	.	.	0.0009	.	0.001	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	0.002	.	0.004	0.003
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	3	5.6
CN	UG/L	.	.	.	.	.	.	.	.	.	1.45	3.638
RA	MG/L	.	.	.	.	.	.	.	.	.	1.145	5.686
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	0.019	0.026
TDS	MG/L	.	365	313	.	.	.	.	.	.	287.272	299.357

TABLE A5.8

NORTH SASK RIVER

ANNUAL MEANS

HIGHWAY 16 CROSSING/BORDEN BRIDGE (STA 27)

PARAMETER		70	71	72	73	74	75	YEAR 76	77	78	79	80	81	82
DO	MG/L	8.9	7.025	7.1	9.425	11.533	9.05	9.425	11.566	9.8	10.3	10.342	9.221	9.994
SAT	%	87.666	50.75	65.5	71.333	96.333	82	75.75	107	92.875	80.857	97.7	86.163	93.35
TOC	MG/L	.	.	.	.	12.2	6.333	5.475	9	5.544	4.333	9.875	10.136	5.303
BOD	MG/L	2.566	1.2	1.133	1.3	2.24	4.866	2.3	2.466	2.028	2.357	2.177	1.936	2.959
TKN	MG/L	.	0.8	1.226	0.75	1.5	1.033	1.3	0.766	0.59	0.855	0.822	0.595	0.744
NO3N	MG/L	.	0.52	0.523	0.342	0.271	0.193	0.397	0.193	0.257	0.239	0.174	0.248	0.341
NH3N	MG/L	0.666	0.79	0.47	0.247	0.26	0.113	0.487	0.039	0.162	0.069	0.095	0.047	0.068
TP	MG/L	0.115	0.085	0.093	0.037	0.064	0.026	0.032	0.153	0.159	0.308	0.133	0.168	0.127
OP	MG/L	0.056	0.067	0.05	0.019	0.031	0.014	0.009	0.03	0.046	0.045	0.031	0.043	0.043
PH	UNITS	8.3	7.925	7.633	7.975	8.14	8.133	8.15	8.333	8.33	7.766	8.033	8.009	8.326
TALK	MG/L	148.333	187.25	154.666	155.75	162.75	149.333	140	138.666	143.4	144.888	157.333	141.136	146.65
COND	US/CM	393.333	500	383.333	418.75	342.5	350	350	316.666	344	413.333	375.555	350.5	395.43
THARD	MG/L	234	.	208	216	176	.	.	.	.	160	.	165.090	180
NA	MG/L	35	35.5	29.5	16.5	22.5	27.5	.	.	.	13	.	10.2	11.889
MG	MG/L	.	.	.	19	18	.	.	.	.	14	.	15.142	17.269
CA	MG/L	.	.	.	54	42	.	.	.	.	40	.	41.625	41.576
CL	MG/L	18	26.75	18.666	11	10	16	9.5	6.633	5.39	7.555	3.744	10.454	13.684
K	MG/L	.	.	.	.	.	.	.	.	.	2	.	2.3	1.925
SO4	MG/L	86	74	68	55	58.6	78	.	.	.	50	54	47.727	43.148
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	.	6	11.4
TSS	MG/L	77	7.5	116.266	17.75	60.6	31.666	34.5	34.333	83.4	13	72.888	97.590	40.567
TURB	NTU	.	.	.	.	.	.	.	.	.	.	.	19.75	11.925
AL	MG/L	.	.	.	.	.	.	.	.	0.61	1.156	0.78	0.722	0.938
AS	UG/L	.	.	.	.	.	.	.	.	1.495	5.16	1.867	1.3	1.042
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.088	0.088
B	MG/L	.	.	.	.	.	.	.	.	0.06	0.1	.	.	0.034
CD	MG/L	.	.	.	.	.	.	.	.	0.09	0.036	0.015	0.005	0.0007
CR	MG/L	.	.	.	.	.	.	.	.	0.005	0.030	0.005	0.016	0.007
CO	MG/L	.	.	.	.	.	.	.	.	0.002	0.09	0.006	0.0009	0.001
CU	MG/L	.	.	.	.	.	.	.	.	0.016	0.015	0.017	0.008	0.012
PB	MG/L	.	.	.	.	.	.	.	.	0.003	0.018	0.007	0.002	0.01
HG	UG/L	.	.	.	.	.	.	.	.	0.096	0.096	0.079	0.145	0.022
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.004	0.004
NI	MG/L	.	.	.	.	.	.	.	.	0.006	0.004	0.026	0.027	0.018
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.0009	0.005
AG	MG/L	.	.	.	.	.	.	.	.	0.09	.	.	.	0.001
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.009	0.008
ZN	MG/L	.	.	.	.	.	.	.	.	0.09	0.16	0.111	0.062	0.042
24D	UG/L	.	.	.	.	.	.	.	.	.	.	0.24	0.086	0.061
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	0.0009	0.002	0.0009
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	0.001	0.004	0.003
PHENOLS	UG/L	.	2	.	.	.	.	.	.	.	.	.	6.5	3.375
CN	UG/L	.	.	.	.	.	.	.	.	.	0.83	0.66	1.65	2.377
RA	MG/L	.	.	.	.	.	.	.	.	.	.	.	2.477	0.080
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.012	0.303
TDS	MG/L	422	.	394	375	.	.	.	.	.	277	.	278	293.592

TABLE A5.9

NORTH SASK RIVER

ANNUAL MEANS

HIGHWAY 12 CROSSING (STA 29)

PARAMETER		YEAR 71	72	73	74	75	76	77	78	80	81	82
DO	MG/L	9.7	9.133	12.8	12.55	10.4	7.6	12.8	7.9	.	10.05	7.716
SAT	%	63.5	66.666	99	112.5	91.5	55.5	104	58	.	101.45	79.833
TOC	MG/L	.	.	.	11.666	6	2.6	11	0.95	7	6.5	7.991
BOD	MG/L	0.9	4.575	1.7	2.933	4.1	1.533	1	0.6	3.8	2.6	3.583
TKN	MG/L	1.32	1.306	1.55	1.2	1.6	1.4	0.6	0.5	0.9	0.9	1
NO3N	MG/L	0.52	0.675	0.43	0.112	0.226	0.54	0.07	0.385	0.14	0.149	0.128
NH3N	MG/L	0.795	0.535	0.53	0.03	0.126	0.666	0.03	0.39	0.09	0.115	0.036
TP	MG/L	0.05	0.097	0.05	0.033	0.033	0.04	0.05	0.11	0.16	0.24	0.211
OP	MG/L	0.05	0.057	0.025	0.009	0.0145	0.009	0.06	0.075	0.01	0.04	0.027
PH	UNITS	7.95	7.625	7.6	8.3	8.166	8	8.5	7.6	8.6	8.55	8.275
TALK	MG/L	198	177.5	123	170	138.666	154.666	154	135	144	140	135.75
COND	US/CM	550	450	325	366.666	350	400	300	300	350	370	330.25
THARD	MG/L	.	216	164	.	.	.	.	.	.	.	154
NA	MG/L	40	28.75	21	20.666	24	.	.	.	.	.	10
MG	MG/L	.	.	18	.	.	.	.	.	.	.	15.375
CA	MG/L	.	.	37	.	.	.	.	.	.	.	37
CL	MG/L	36.5	18.75	7	14.333	17.666	14.666	12	7	2	3.95	5.5
K	MG/L	.	.	.	.	.	.	.	.	.	.	2.75
SO4	MG/L	93	77	77	60.333	71.5	.	.	.	.	.	38.25
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	73.5
TSS	MG/L	6	16.5	12.5	32.333	34	11.333	20	7	133	149.5	264.166
TURB	NTU	.	.	.	.	.	.	.	.	.	.	135
AL	MG/L	.	.	.	.	.	.	.	.	.	.	6.67
AS	UG/L	.	.	.	.	.	.	.	.	.	.	2.422
BA	MG/L	.	.	.	.	.	.	.	.	.	.	0.103
B	MG/L	.	.	.	.	.	.	.	.	.	.	0.019
CD	MG/L	.	.	.	.	.	.	.	.	.	.	0.0007
CR	MG/L	.	.	.	.	.	.	.	.	.	.	0.013
CO	MG/L	.	.	.	.	.	.	.	.	.	.	0.003
CU	MG/L	.	.	.	.	.	.	.	.	.	.	0.016
PB	MG/L	.	.	.	.	.	.	.	.	.	.	0.005
HG	UG/L	.	.	.	.	.	.	.	.	.	.	0.019
MO	MG/L	.	.	.	.	.	.	.	.	.	.	0.007
NI	MG/L	.	.	.	.	.	.	.	.	.	.	0.012
SE	MG/L	.	.	.	.	.	.	.	.	.	.	0.004
AG	MG/L	.	.	.	.	.	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	0.016
ZN	MG/L	.	.	.	.	.	.	.	.	.	.	0.041
24D	UG/L	.	.	.	.	.	.	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	.
PHENOLS	UG/L	.	.	1.3	.	.	.	.	.	.	.	2.5
CN	UG/L	.	.	.	.	.	.	.	.	.	.	2.872
RA	MG/L	.	.	.	.	.	.	.	.	.	.	0.102
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	.	0.009
TDS	MG/L	.	401	317	.	.	.	.	.	.	.	259.375

TABLE A5.10

NORTH SASK RIVER
ANNUAL MEANS
WINGARD FERRY (STA 32)

PARAMETER		71	72	76	78	82
		YEAR				
DO	MG/L	8.6	4.8	6.8	8.1	8.6
SAT	%	62	34.5	52	.	84.75
TOC	MG/L	.	.	7	0.9	6.8
BOD	MG/L	0.95	0.75	1	0.8	3.56
TKN	MG/L	1.62	1.84	1.2	0.4	0.75
NO3N	MG/L	0.59	0.735	0.41	0.81	0.112
NH3N	MG/L	0.69	0.78	0.92	0.19	0.028
TP	MG/L	0.06	0.08	0.06	0.07	0.113
OP	MG/L	0.055	0.05	0.03	0.07	0.021
PH	UNITS	8	7.5	8.1	7.6	8.4
TALK	MG/L	198	169	156	136	139.2
COND	US/CM	525	450	400	400	349.3
THARD	MG/L	.	224	.	.	160.666
NA	MG/L	39	27	17	.	11
MG	MG/L	.	.	.	.	13.666
CA	MG/L	.	.	.	.	40.166
CL	MG/L	43	19	17	26	5.6
K	MG/L	.	.	.	.	2.333
SO4	MG/L	90	75.5	60	.	39.333
COLOR	UNITS	.	.	.	.	42.5
TSS	MG/L	12	17.25	10	8	52.4
TURB	NTU	.	.	.	.	55
AL	MG/L	.	.	.	.	1.545
AS	UG/L	.	.	.	.	1.097
BA	MG/L	.	.	.	.	0.103
B	MG/L	.	.	.	.	0.063
CD	MG/L	.	.	.	.	0.0007
CR	MG/L	.	.	.	.	0.007
CO	MG/L	.	.	.	.	0.001
CU	MG/L	.	.	.	.	0.012
PB	MG/L	.	.	.	.	0.006
HG	UG/L	.	.	.	.	0.024
MO	MG/L	.	.	.	.	0.004
NI	MG/L	.	.	.	.	0.006
SE	MG/L	.	.	.	.	0.004
AG	MG/L	.	.	.	.	0.001
U	UG/L	.	.	.	.	0.009
V	MG/L	.	.	.	.	0.009
ZN	MG/L	.	.	.	.	0.018
24D	UG/L	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.
PHENOLS	UG/L	.	.	.	.	2
CN	UG/L	.	.	.	.	2.075
RA	MG/L	.	.	.	.	0.094
SULPHIDE	MG/L	.	.	.	.	0.009
TDS	MG/L	.	396	.	.	269.666

TABLE A5.11

NORTH SASK RIVER
ANNUAL MEANS
CRUTWELL FERRY (STA 33)
YEAR

PARAMETER		82
DO	MG/L	9.825
SAT	%	94.75
TOC	MG/L	7.126
BOD	MG/L	3.4
TKN	MG/L	1.033
NO3N	MG/L	0.388
NH3N	MG/L	0.063
TP	MG/L	0.202
OP	MG/L	0.029
PH	UNITS	8.12
TALK	MG/L	132.466
COND	US/CM	344.266
THARD	MG/L	153.818
NA	MG/L	12.181
MG	MG/L	13.818
CA	MG/L	39.363
CL	MG/L	5.6
K	MG/L	3.454
SO4	MG/L	49
COLOR	UNITS	13
TSS	MG/L	236.4
TURB	NTU	123.428
AL	MG/L	1.01
AS	UG/L	0.563
BA	MG/L	0.095
B	MG/L	0.03
CD	MG/L	0.0007
CR	MG/L	0.007
CO	MG/L	0.0009
CU	MG/L	0.007
PB	MG/L	0.004
HG	UG/L	0.019
MO	MG/L	0.004
NI	MG/L	0.003
SE	MG/L	0.0009
AG	MG/L	0.0009
U	UG/L	.
V	MG/L	0.009
ZN	MG/L	0.028
24D	UG/L	.
LINDANE	UG/L	.
ALPHABHC	UG/L	.
PHENOLS	UG/L	2
CN	UG/L	0.093
RA	MG/L	0.071
SULPHIDE	MG/L	5.168
TDS	MG/L	273.909

TABLE A5.12

NORTH SASK RIVER

ANNUAL MEANS

PRINCE ALBERT WATER TREATMENT PLANT INTAKE (STA 36)

PARAMETER		YEAR 71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	10.358	8.342	9.385	9.062	9.564	10.553	9.607	9.355	9.02	8.075	10.837	9.633
SAT	%	91.5	73.315	86.214	82	85.076	100.090	85.083	88.875	82	78.7	91.512	75.333
TOC	MG/L	.	.	15	14.807	6.562	8.294	8.066	7.655	5.625	11.8	11.5	3
BOD	MG/L	3.692	2.542	3.753	2.441	3.533	2.787	1.985	2.771	2.5	5.275	3.79	2.575
TKN	MG/L	1.033	1.281	1.238	1.35	1.459	1.6	0.450	0.527	0.612	0.8	0.655	1
NO3N	MG/L	0.181	0.352	0.253	0.316	0.463	0.208	0.290	0.358	0.271	0.146	0.316	0.393
NH3N	MG/L	0.447	0.456	0.323	0.400	0.291	0.596	0.130	0.099	0.066	1.787	0.673	0.213
TP	MG/L	0.056	0.098	0.090	0.038	0.0405	0.033	0.113	0.098	0.103	0.158	0.387	0.116
OP	MG/L	0.023	0.043	0.026	0.014	0.0217	0.013	0.028	0.040	0.040	0.187	0.132	0.08
PH	UNITS	8.042	8.005	8.013	8.188	8.143	8.276	8.166	8.136	7.925	8.083	7.99	7.985
TALK	MG/L	155.642	172.210	159.866	157.411	160	149.25	144.066	147	157.25	155.727	156	168.833
COND	US/CM	376.538	380.263	498.333	386.666	398.187	373.529	362.4	367.545	440	370.833	387.5	453.333
THARD	MG/L	.	.	.	.	.	.	.	208	220	.	.	.
NA	MG/L	26.636	25.684	41.066	19.777	23.25	15.25	11.222	18	12.5	.	.	.
MG	MG/L	.	.	.	.	.	.	.	22	22	.	.	.
CA	MG/L	.	.	.	.	.	.	.	46	51	.	.	.
CL	MG/L	13.492	12.368	28.266	11.277	14.2	7.312	7.05	11	6.5	10.783	9.18	15
K	MG/L	.	.	.	.	.	.	.	1	1	.	.	.
SO4	MG/L	60	58.052	67.066	57.888	69	57.166	57.444	60	48	50	.	.
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	9	.
TSS	MG/L	56.136	103.152	116.266	167.058	58.625	27.5	26.666	37.363	40.75	92	88.1	19.333
TURB	NTU	.	.	.	.	.	2.8	.	.	.	.	.	.
AL	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.11
AS	UG/L	.	.	.	.	.	1	.	.	.	.	.	0.49
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.042
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.01
CD	MG/L	.	.	.	.	.	0.0002	.	.	.	.	.	0.0009
CR	MG/L	.	.	.	.	.	0.001	.	.	.	.	.	0.003
CO	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.0009
CU	MG/L	.	.	.	.	.	0.048	.	.	.	.	.	0.004
PB	MG/L	.	.	.	.	.	0.0019	.	.	.	.	.	0.004
HG	UG/L	.	.	.	.	.	.	0.069	0.09	0.09	0.117	0.09	0.021
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.004
NI	MG/L	.	.	.	.	.	0.004	.	.	.	.	.	0.0009
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.0009
AG	MG/L	.	.	.	.	.	0.0001	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	2.3
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.009
ZN	MG/L	.	.	.	.	.	0.0007	.	.	.	.	.	0.069
24D	UG/L	.	.	.	.	.	.	.	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	.	.
PHENOLS	UG/L	6	.	.	.	.	.	.	.	.	.	.	.
CN	UG/L	.	.	.	.	.	.	.	.	.	.	.	0.7
RA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.
SULPHIDE	MG/L	.	.	.	.	.	.	0.019	.	.	.	.	.
TDS	MG/L	.	.	.	.	.	.	.	348	348	.	.	.

TABLE A5.13

NORTH SASK RIVER

ANNUAL MEANS

PRINCE ALBERT PULP COMPANY INTAKE (STA 42)

							YEAR						
PARAMETER		70	71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	13.7	7.842	8.16	9.193	9.022	9.264	10.1	10.133	9.862	9.55	9.814	12.24	9.877
SAT	%	101	69.142	70.9	83.937	77.5	80.714	114.666	97	95.571	99.333	95.914	95.76	83
TOC	MG/L	.	.	.	14.5	15.617	7.125	10.5	9.111	8.842	7	9.285	9.4	8.8
BOD	MG/L	1	2.148	1.79	3.081	3.447	3.233	3.4	2.243	2.85	2.7	2.175	0.74	1.771
TKN	MG/L	.	1.126	1.1	1.53	1.395	1.368	1.737	0.548	0.725	0.7	0.912	0.4	1.2
NO3N	MG/L	.	0.138	0.376	0.419	0.283	0.396	0.084	0.209	0.364	0.546	0.133	0.317	0.568
NH3N	MG/L	0.4	0.598	0.533	0.371	0.372	0.280	0.595	0.047	0.097	0.024	0.035	0.099	0.141
TP	MG/L	0.03	0.095	0.086	0.083	0.038	0.065	0.043	0.152	0.127	0.14	0.142	0.094	0.256
OP	MG/L	0.009	0.034	0.036	0.020	0.0153	0.031	0.012	0.017	0.048	0.024	0.024	0.048	0.074
PH	UNITS	8.1	7.617	7.95	7.956	8.09	8.093	8.3	8.362	8.125	8.05	8.142	8.04	7.871
TALK	MG/L	211	161.896	172.1	172.75	175.736	166.375	147.75	140.666	142.5	162.5	160.125	160.8	142.857
COND	US/CM	600	434.827	400	460.937	409.5	398.125	408	328.333	340	460	362.5	386.4	374.357
THARD	MG/L	.	266	.	.	.	.	.	.	.	.	.	.	150
NA	MG/L	.	29.913	26.35	23.812	18.55	22.25	15.25	11.555	12.25	18	11.375	11.5	12.142
MG	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	13.125
CA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	39
CL	MG/L	68	25.862	13.05	11.75	11.5	13.2	5.5	4.633	7.875	5	3.45	5.2	6.714
K	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	4.875
SO4	MG/L	.	62.782	61.5	117.812	63.263	74.625	58	50.888	41.375	60.666	44.125	45.75	55.285
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	21	7.75	10.285
TSS	MG/L	22.5	108.767	99.98	108.468	211.342	68.687	58.125	65.666	70.125	120.25	202	31.6	229.5
TURB	NTU	.	.	.	.	.	.	.	.	.	.	.	0.009	125.5
AL	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	1.6
AS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.6
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.087
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CD	MG/L	.	.	.	.	.	.	.	.	0.09	.	.	.	0.0004
CR	MG/L	.	.	.	.	.	.	.	.	0.016	.	.	.	0.001
CO	MG/L	.	.	.	.	.	.	.	.	0.002	.	.	.	0.0009
CU	MG/L	.	.	.	.	.	.	.	.	0.007	.	.	.	0.037
PB	MG/L	.	.	.	.	.	.	.	.	0.001	.	.	.	0.008
HG	UG/L	.	.	.	.	.	0.09	.	0.074	0.09	.	0.09	0.02	0.019
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.004
NI	MG/L	.	.	.	.	.	.	.	.	0.005	.	.	.	0.006
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.0009
AG	MG/L	.	.	.	.	.	.	.	.	0.09	.	.	.	.
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.009
ZN	MG/L	.	.	.	.	.	.	.	.	0.09	.	.	.	0.056
24D	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	3
CN	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.09
RA	MG/L	.	.	.	.	.	.	.	0.132	0.298	0.427	0.261	0.067	0.110
SULPHIDE	MG/L	.	.	.	.	.	0.01	.	0.026	0.065	0.009	0.010	0.009	0.031
TDS	MG/L	.	513	.	.	.	.	.	.	.	.	.	.	273.125

TABLE A5.14

NORTH SASK RIVER

ANNUAL MEANS

CECIL FERRY NORTH (STA 44N)

PARAMETER		YEAR												
		70	71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	7.7	7.515	8.05	8.731	8.813	9.2	9.586	9.053	9.966	10.2	9.212	9.4	8.887
SAT	%	72	67.538	70.5	80.125	76.142	82.437	89.769	82.538	96.125	87.142	86.4	78.487	73.875
TOC	MG/L	.	.	.	23.5	21.861	12.375	15.333	14.4	12.375	12.444	16.666	15.777	8.362
BOD	MG/L	15.75	11.855	5.1	4.194	4.231	4.275	4.307	3.741	4.3	18.866	2.866	1.266	3.222
TKN	MG/L	.	1.62	1.416	2.011	1.966	1.474	1.673	0.650	0.866	0.822	0.85	0.633	1.016
NO3N	MG/L	.	0.121	0.343	1.264	0.333	0.366	0.217	0.207	0.318	0.252	0.210	0.407	0.448
NH3N	MG/L	0.475	0.647	0.581	0.440	0.505	0.373	0.623	0.148	0.102	0.067	0.083	0.064	0.144
TP	MG/L	0.056	0.107	0.116	0.091	0.043	10.042	0.098	0.087	0.178	0.104	0.126	0.138	0.143
OP	MG/L	0.027	0.033	0.040	0.031	0.024	0.025	0.034	0.016	0.051	0.038	0.023	0.044	0.080
PH	UNITS	7.65	7.640	7.83	7.805	8.009	8.043	8.02	8.028	8.011	7.722	7.92	7.9	7.916
TALK	MG/L	164.5	164.814	168.95	163.294	183.684	164.533	170.4	143.8	144.888	165.555	155.5	158.777	153.333
COND	US/CM	525	467.592	436.25	442.647	429.523	425.2	426.666	397.666	388.222	521.666	392	427.333	434.833
THARD	MG/L	242	276	.	.	.	.	144	.	.	.	.	.	182
NA	MG/L	55	40.380	36.45	29.647	27.238	28.437	26.542	18.933	20.125	28.375	25	22.444	21.4
MG	MG/L	.	.	.	.	.	.	13	.	.	.	.	.	13.25
CA	MG/L	.	.	.	.	.	.	37	.	.	.	.	.	40.5
CL	MG/L	43.5	35.703	27.2	21.647	24	21.857	26.571	18.86	18.666	29.111	17.8	21.333	19.5
K	MG/L	.	.	.	.	.	.	3	.	.	.	.	.	3.75
SO4	MG/L	94	67.952	65.4	65.176	62.8	72.133	62	59.066	48.888	57.75	53.2	50.888	54.4
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	36.75	76	52.142
TSS	MG/L	88.375	152.346	115.925	77.852	214.15	48	42.466	32.466	64.333	26.888	254.3	78.555	122.416
TURB	NTU	.	.	.	.	.	.	.	.	.	.	.	.	136.666
AL	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	5.2
AS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	2.8
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.14
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.01
CD	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.0009
CR	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.014
CO	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.002
CU	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.016
PB	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.004
HG	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.04
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.005
NI	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.012
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.009
AG	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.02
ZN	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.022
24D	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	6
CN	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	8
RA	MG/L	.	.	.	.	.	.	0.09	0.15	0.308	0.577	0.264	0.873	0.157
SULPHIDE	MG/L	.	.	.	.	.	0.03	0.076	0.074	0.101	0.106	0.019	0.419	0.041
TDS	MG/L	486	565	.	.	.	.	270	.	.	.	.	.	272.5

TABLE A5.15

NORTH SASK RIVER

ANNUAL MEANS

CECIL FERRY SOUTH (STA 44S)

PARAMETER		YEAR 70	71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	9.9	7.808	8.426	9.431	9.333	9.633	10.25	9.738	9.777	9.216	8.687	9.925	8.942
SAT	%	91.5	70.2	74.684	86.187	81.882	86.8	95.916	89.666	93.75	69.857	75.655	83.05	74.657
TOC	MG/L	.	.	.	13.5	17.357	7.062	7.941	7.642	8.4875	4.322	10.666	8.777	7.5
BOD	MG/L	3.9	3.02	2.878	3.025	2.821	3.475	2.95	2.385	3.214	3.05	1.733	1.25	2.290
TKN	MG/L	.	0.933	1.18	1.362	1.36	1.243	1.417	0.577	0.87	0.6	0.84	0.5	1.158
NO3N	MG/L	.	0.171	0.375	0.280	0.928	0.346	0.294	0.259	0.323	0.297	0.180	0.328	0.413
NH3N	MG/L	0.525	0.628	0.545	0.364	0.418	0.337	0.622	0.196	0.122	0.108	0.115	0.071	0.149
TP	MG/L	0.146	0.117	0.097	0.088	0.033	0.043	0.053	0.123	0.144	0.093	0.101	0.133	0.215
OP	MG/L	0.042	0.043	0.037	0.029	0.017	0.020	0.020	0.021	0.045	0.033	0.032	0.051	0.059
PH	UNITS	7.925	7.72	8.026	8.118	8.125	7.943	8.188	8.228	8.18	7.788	7.87	8.033	7.925
TALK	MG/L	155.5	172.24	167.842	155.687	163.157	146.812	150.823	139	134.6	158.444	149.7	152.333	151.583
COND	US/CM	437.5	419.2	396.052	385.937	386.5	398.25	385.294	361.866	354.9	435.555	357	403.5	392.583
THARD	MG/L	222	268	.	.	.	.	208	.	108	.	.	.	154
NA	MG/L	35	30.3	27.157	21.25	20.2	22.75	15.461	11.571	15	28	6	10	11.5
MG	MG/L	.	.	.	.	.	.	21	.	.	.	.	.	13.25
CA	MG/L	.	.	.	.	.	.	48	.	.	.	.	.	40
CL	MG/L	20.5	21.92	13.157	9.937	12.3	14.533	9.117	6.446	8.8	6.222	5.17	7.1	7.991
K	MG/L	.	.	.	.	.	.	2	.	16	.	.	.	3.75
SO4	MG/L	9	62	56.684	56.562	57.052	81	59.416	56.142	48	.	37	40	42
COLOR	UNITS	.	.	.	.	.	.	.	.	.	.	12.333	15.8	9.333
TSS	MG/L	137.35	140.733	95.110	82.156	176.184	32	30.352	27.8	59.5	23.888	130.1	69.555	97.25
TURB	NTU	.	.	.	.	.	.	.	.	.	.	.	.	155
AL	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
AS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
B	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CD	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CR	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CO	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CU	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
PB	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
HG	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
NI	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
AG	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
ZN	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
24D	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
CN	UG/L	.	.	.	.	.	.	.	.	.	.	.	.	.
RA	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.059
SULPHIDE	MG/L	.	.	.	.	.	.	.	.	.	.	.	.	0.154
TDS	MG/L	430	506	.	.	.	.	355	.	.	.	.	.	266.75

TABLE A5.16

NORTH SASK RIVER

ANNUAL MEANS

COLE RAPIDS (STA 46)

		YEAR											
PARAMETER		71	72	73	74	75	76	77	78	79	80	81	82
DO	MG/L	7.078	8.544	8.514	9.430	8.833	9.855	10.44	10.15	9.6	10.328	10.662	10.14
SAT	%	71.5	87.333	77.142	84.916	78.666	92.142	94	99.6	94.2	99.885	87.725	92
TOC	MG/L	.	.	15.25	14.15	10.2	8	10.666	10.857	4.857	13.625	8.222	6.35
BOD	MG/L	3.314	2.333	2.125	3.085	2.48	3.044	2.28	3.383	1.72	1.775	1.342	2.825
TKN	MG/L	.	0.701	1.125	1.278	1.179	1.255	0.613	0.675	0.614	2.044	0.6	1.044
NO3N	MG/L	0.054	0.169	0.344	0.230	0.407	0.247	0.191	0.37	0.201	0.174	0.325	0.328
NH3N	MG/L	0.486	0.327	0.365	0.335	0.243	0.567	0.048	0.122	0.076	0.048	0.049	0.072
TP	MG/L	0.091	0.087	0.063	0.036	0.042	0.038	0.183	0.158	0.092	0.123	0.151	0.205
OP	MG/L	0.030	0.023	0.032	0.015	0.018	0.013	0.033	0.046	0.026	0.028	0.047	0.043
PH	UNITS	7.723	8.144	7.9	8.207	8.04	8.255	8.3	8.125	7.985	7.933	7.977	8.116
TALK	MG/L	147.428	151.111	166.5	167.357	163.555	147.777	139.5	142	162	141.333	153.555	148.055
COND	US/CM	381.428	361.111	400	409.285	410	377.777	343	337.25	464.285	332.222	374.666	380.833
THARD	MG/L	256	.	.	.	.	.	.	.	174	224	.	159.555
NA	MG/L	31.230	24	20.375	21	23.5	14.222	12.4	12.357	16.571	12.444	14.444	14.75
MG	MG/L	.	.	.	.	.	.	.	.	17.5	.	.	16
CA	MG/L	.	.	.	.	.	.	.	.	40.5	.	.	37.125
CL	MG/L	19.571	7.777	13.75	14.357	15	9.888	7.333	6.375	7.714	5.077	9.555	10.5555
K	MG/L	.	.	.	.	.	.	.	.	2	2	.	3.875
SO4	MG/L	54.692	44.888	59.875	59.357	75.2	56.777	55.333	45.714	54	44.111	52.535	44.6
COLOR	UNITS	.	.	.	.	.	.	.	.	.	16.5	15.857	23.166
TSS	MG/L	122.142	121.433	76.25	110.785	32.9	25	56	96	29	188.88	105.555	189.833
TURB	NTU	.	.	.	.	.	.	.	.	.	.	.	124
AL	MG/L	.	.	.	.	.	.	.	1.04	0.345	1.11	0.72	3.04
AS	UG/L	.	.	.	.	.	.	.	2	0.945	1.16	3	1.515
BA	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.167
B	MG/L	.	.	.	.	.	.	.	0.08	.	.	0.02	0.009
CD	MG/L	.	.	.	.	.	.	.	0.09	0.019	0.013	0.012	0.001
CR	MG/L	.	.	.	.	.	.	.	0.008	0.001	0.006	0.010	0.010
CO	MG/L	.	.	.	.	.	.	.	0.003	0.09	0.011	0.001	0.001
CU	MG/L	.	.	.	.	.	.	.	0.008	0.001	0.023	0.006	0.012
PB	MG/L	.	.	.	.	.	.	.	0.005	0.002	0.016	0.018	0.007
HG	UG/L	.	.	.	.	.	.	0.0695	0.143	0.09	0.076	0.116	0.022
MO	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.006
NI	MG/L	.	.	.	.	.	.	.	0.0049	0.004	0.014	0.015	0.007
SE	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.004
AG	MG/L	.	.	.	.	.	.	.	0.09	.	.	.	0.0009
U	UG/L	.	.	.	.	.	.	.	.	.	.	.	0.009
V	MG/L	.	.	.	.	.	.	.	.	.	.	.	0.013
ZN	MG/L	.	.	.	.	.	.	.	0.09	0.034	0.029	0.077	0.037
24D	UG/L	.	.	.	.	.	.	.	0.49	0.003	0.051	0.102	.
LINDANE	UG/L	.	.	.	.	.	.	.	.	0.0009	0.0009	0.0009	3.33
ALPHABHC	UG/L	.	.	.	.	.	.	.	.	0.02	0.006	0.003	6.7
PHENOLS	UG/L	.	.	.	.	.	.	.	.	.	.	.	4.25
CN	UG/L	.	.	.	.	.	.	.	.	1.1	2.083	2	1.43
RA	MG/L	.	.	.	.	.	0.09	0.15	0.268	0.452	0.273	0.498	0.052
SULPHIDE	MG/L	.	.	.	.	.	0.02	0.0357	0.019	0.039	0.010	0.012	0.094
TDS	MG/L	499	.	.	.	.	.	.	.	325	.	.	275.714

APPENDIX 6

HEAVY AND TRACE METAL CONTENT OF SUSPENDED SOLIDS AT VARIOUS SITES ALONG THE NORTH SASKATCHEWAN RIVER IN JULY, 1981

APPENDIX 6: Heavy and trace metal content of suspended solids at various sites along the North Saskatchewan River in July, 1981.*

Sampling Location	Date (1981)	LOI %	% Inorganic Content	Portion of Various Particle Size Categories in Samples				Metal Concentration (ug/g. dry weight)												
				<62 um	<4 um	<2 um	<0.45 um	Mercury	Silver	Aluminum	Arsenic	Cadmium	Cobalt	Chromium	Copper	Iron	Manganese	Nickel	Lead	Zinc
Redwater, Alberta	82/07/25 12:39-13:24	5.4	94.6	100	56	38	12	0.08	2.6	29400	5.4	0.20	8.0	32	33	23100	420	26	<2	92
Myrnam, Alberta	82/07/25 17:20-18:33	6.3	93.7	100	56	38	17	0.10	1.5	26100	5.8	0.30	11	32	28	24200	485	35	<2	101
Hwy. #3	82/07/18 10:30-17:10	16.1	83.9	100	38	22	10	0.12	1.4	20800	5.6	0.50	8.7	38	26	17200	513	29	<2	88
Hwy. #3	82/07/20 18:00-18:30	6.9	93.1	98	73	53	24	0.09	2.0	36000	3.4	0.50	12	59	31	29700	527	38	<2	125
Hwy. 3	82/07/22 11:37-12:22	6.4	93.6	100	68	45	14	0.09	1.9	34800	7.1	0.40	1.0	56	1140	28300	483	37	<2	131
Hwy. 3	82/07/26 11:43-13:22	6.5	93.5	100	63	45	17	0.08	1.4	28300	7.8	0.40	26	41	40	28400	530	74	<2	127
Hwy. 21	82/07/19 10:53-12:30	7.8	92.2	98	32	20	7	0.07	1.4	19900	6.5	0.20	12	34	22	20800	558	28	<2	97
Hwy. 21	82/07/22 14:15-15:00	6.3	93.7	100	72	49	16	0.07	1.8	33600	7.4	<0.20	11	49	28	27600	554	35	<2	117
Paynton Ferry	82/07/22 15:42-18:15	6.3	93.7	100	68	46	15	0.08	1.7	33500	7.6	<0.20	11	52	29	27300	554	35	<2	117
Hwy. 16	82/07/19 16:50-22:00	7.3	92.7	97	38	27	16	0.06	1.0	17300	9.4	0.50	7.5	23	26	16300	416	22	<2	70
Hwy. 16	82/07/21 12:05-12:35	6.4	93.6	96	47	33	13	0.07	2.1	28400	4.5	0.40	12	44	36	24100	747	34	<2	120
Hwy. 16	82/07/23 19:04-19:34	6.6	93.4	100	68	43	13	<0.05	1.9	40000	4.0	0.30	11	60	26	32300	521	36	<2	114
Hwy. 16	82/07/26 16:00-17:40	6.3	93.7	100	70	50	15	0.07	1.4	30100	4.3	0.20	11	46	27	29700	531	34	<2	108

APPENDIX 6: Heavy and trace metal content of suspended solids at various sites along the North Saskatchewan River in July, 1981.*

Sampling Location	Date (1981)	LOI %	Inorganic Content %	Portion of Various Particle Size Categories in Samples				Metal Concentration (ug/g. dry weight)												
				<62 um	<4 um	<2 um	<0.45 um	Mercury	Silver	Aluminum	Arsenic	Cadmium	Cobalt	Chromium	Copper	Iron	Manganese	Nickel	Lead	Zinc
Borden Bridge	82/07/21 16:15-17:08	5.5	94.5	98	38	28	15	0.12	1.9	19200	4.2	0.20	8.6	35	24	17600	458	26	<2	78
Borden Bridge	87/07/23 16:00-16:30	7.2	92.8	100	74	48	14	<0.05	1.6	37200	9.6	0.30	11	59	26	30900	528	34	<2	114
Borden Bridge	82/07/26 20:34-21:33	6.4	93.6	100	65	44	14	<0.05	1.4	35400	6.9	0.30	10	52	28	29700	534	34	<2	107
Prince Albert	82/07/27 11:35-12:10	6.7	93.3	100	67	42	11	0.12	1.6	27600	3.6	0.20	11	51	27	32100	556	34	<2	111
Nipawin	82/07/27 15:28-16:14	7.0	93.0	100	78	51	17	0.14	2.5	40800	8.0	0.20	13	53	32	32500	614	37	<2	130

LOI - loss of weight on ignition

< - less than

* - sampling conducted during high flow event.

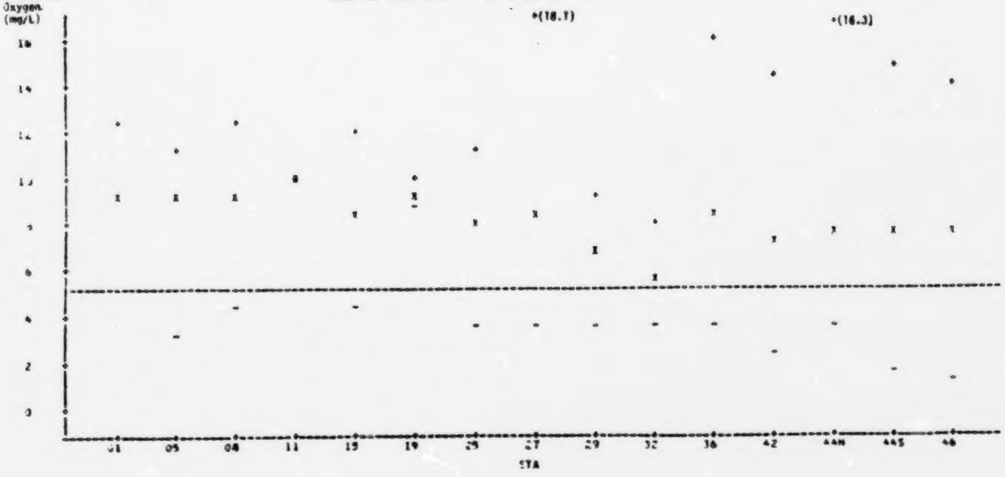
um - 10^{-6} metres.

APPENDIX 7

PLOTS OF MEAN, MAXIMUM, AND MINIMUM VALUES FOR WATER QUALITY VARIABLES DETERMINED AT SITES ALONG THE NORTH SASKATCHWAN RIVER DURING THE PERIOD 1970 TO 1982

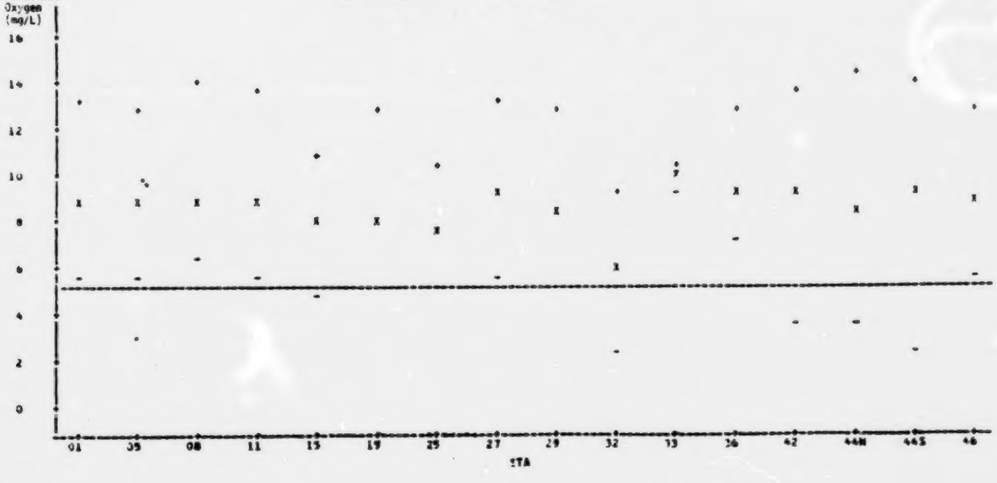
N. SASK R. 1970-1982 16:05 WEDNESDAY, OCTOBER 31, 1984 1
WINTER SEASON
Table A7.1 Dissolved Oxygen (mg/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 16:05 WEDNESDAY, OCTOBER 31, 1984 2
SUMMER SEASON
Table A7.1 Dissolved Oxygen (mg/L)

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



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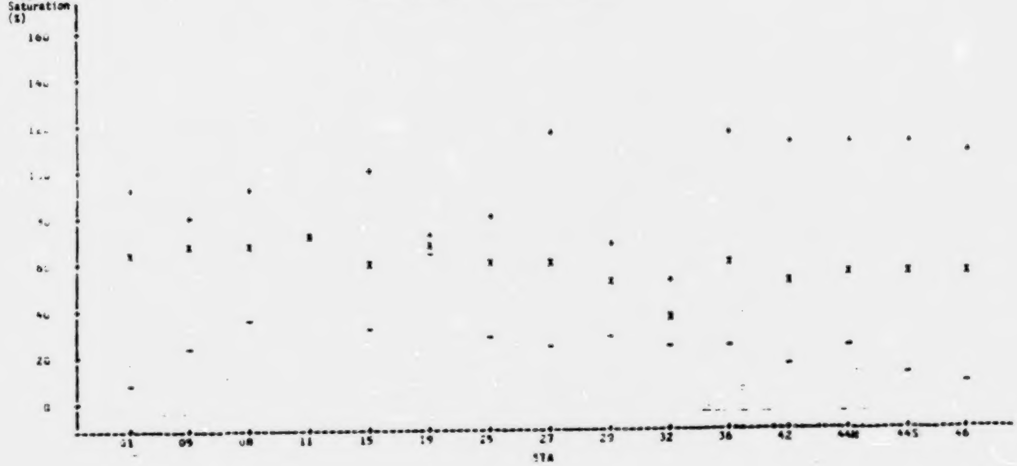
                 N. SASK R. 1970-1982                       11:48 MONDAY, NOVEMBER 5, 1984   11
                    WINTER SEASON
         Table A7.2  Oxygen Saturation (%)
PLOT OF WMEAN*STA    SYMBOL USED IS X
PLOT OF WMIN*STA     SYMBOL USED IS -
PLOT OF WMAX*STA     SYMBOL USED IS +
```



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                 N. SASK R. 1970-1982                       11:48 MONDAY, NOVEMBER 5, 1984   1.
                    SUMMER SEASON
         Table A7.2  Oxygen Saturation (%)
PLOT OF SMEAN*STA    SYMBOL USED IS X
PLOT OF SMIN*STA     SYMBOL USED IS -
PLOT OF SMAX*STA     SYMBOL USED IS +
```
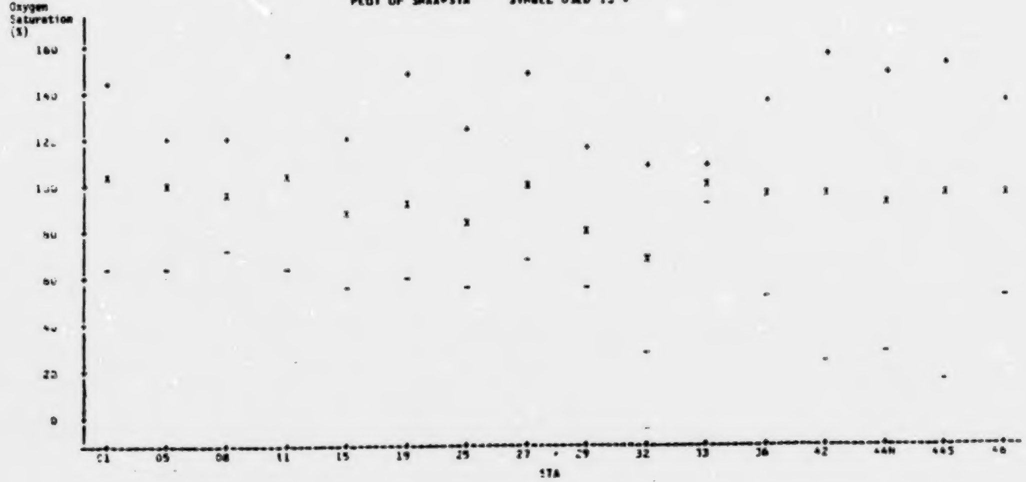
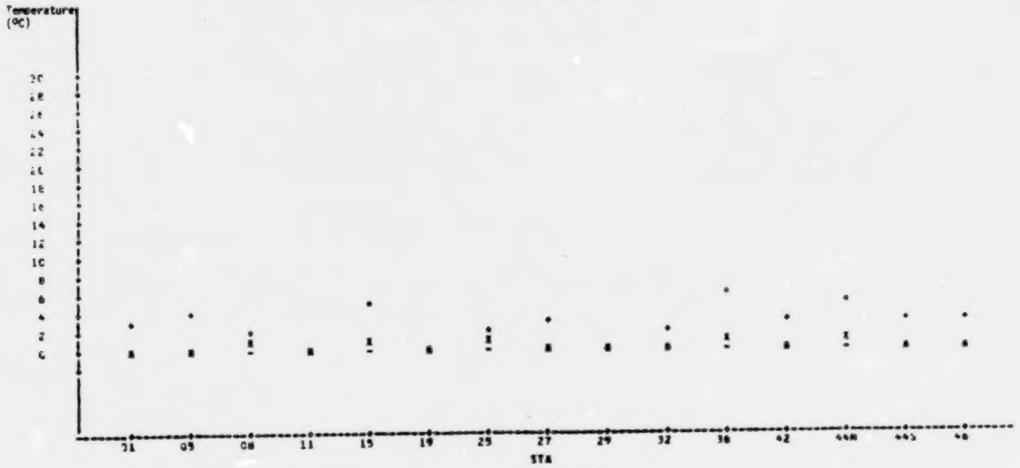



N. SASK R. 1970-1982
WINTER SEASON

8:26 MONDAY, NOVEMBER 26, 1984 3

Table A7.3 Temperature (°C)

```
PLOT OF WMEAN*STA    SYMBOL USED IS X
PLOT OF WMIN*STA     SYMBOL USED IS -
PLOT OF WMAX*STA     SYMBOL USED IS +
```

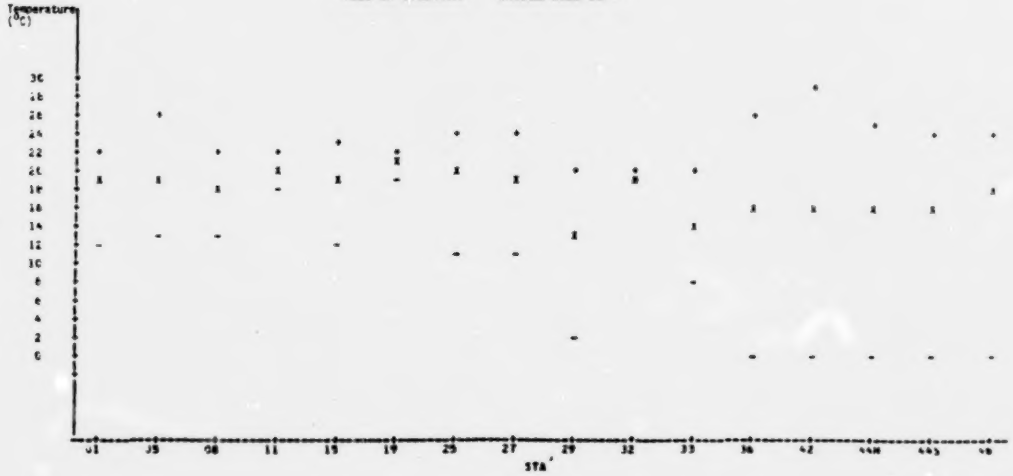


N. SASK R. 1970-1982
SUMMER SEASON

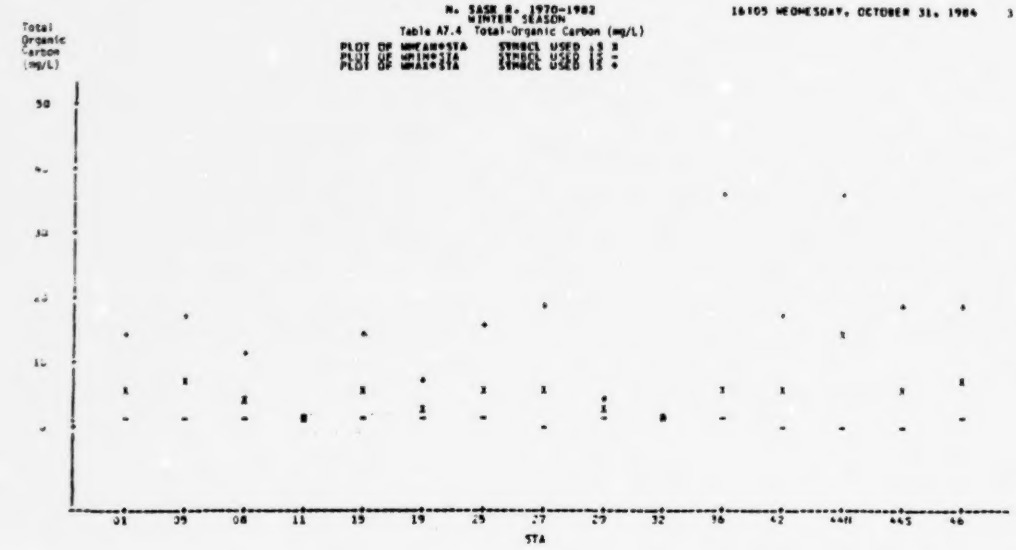
8:26 MONDAY, NOVEMBER 26, 1984 4

Table A7.3 Temperature (°C)

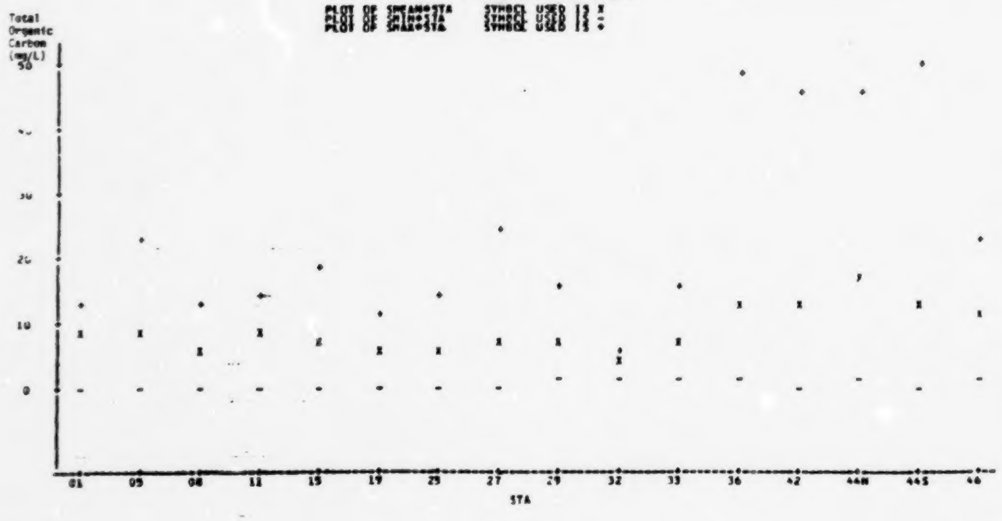
```
PLOT OF SMEAN*STA    SYMBOL USED IS X
PLOT OF SMIN*STA     SYMBOL USED IS -
PLOT OF SMAX*STA     SYMBOL USED IS +
```



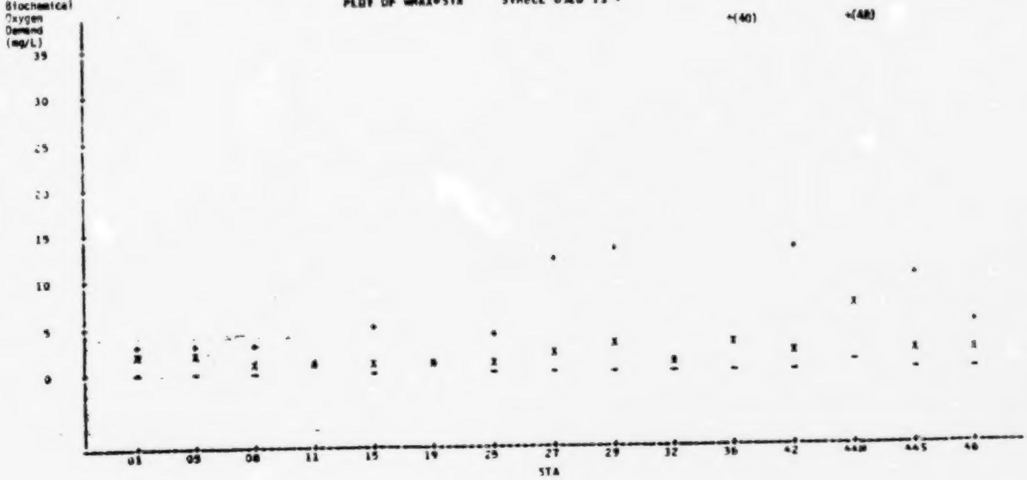
N. SASK R. 1970-1982 16:05 WEDNESDAY, OCTOBER 31, 1984 3
WINTER SEASON
Table A7.4 Total-Organic Carbon (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



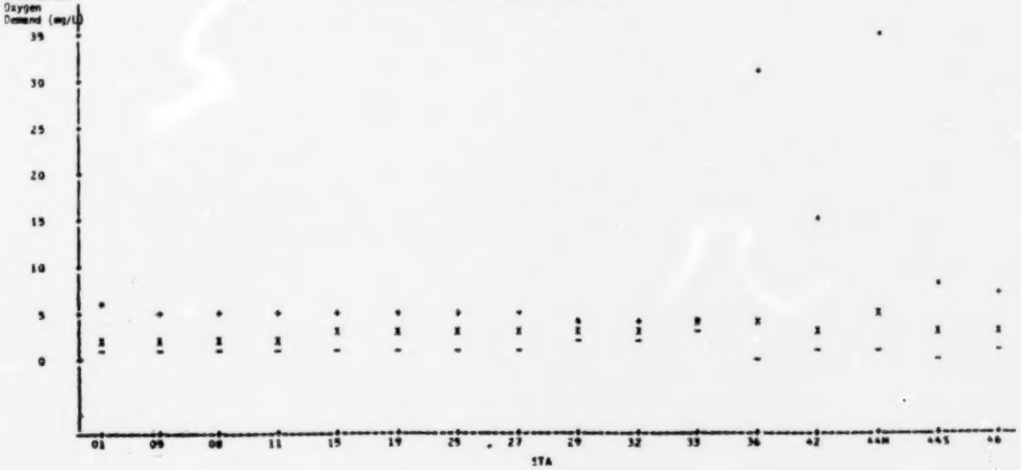
N. SASK R. 1970-1982 16:09 WEDNESDAY, OCTOBER 31, 1984 4
SUMMER SEASON
Table A7.4 Total Organic Carbon (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SAGE R. 1970-1982 13:48 THURSDAY, NOVEMBER 1, 1984 1.
WINTER SEASON
Table A7.5 Biochemical Oxygen Demand (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SAGE R. 1970-1982 13:48 THURSDAY, NOVEMBER 1, 1984 14
SUMMER SEASON
Table A7.5 Biochemical Oxygen Demand (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



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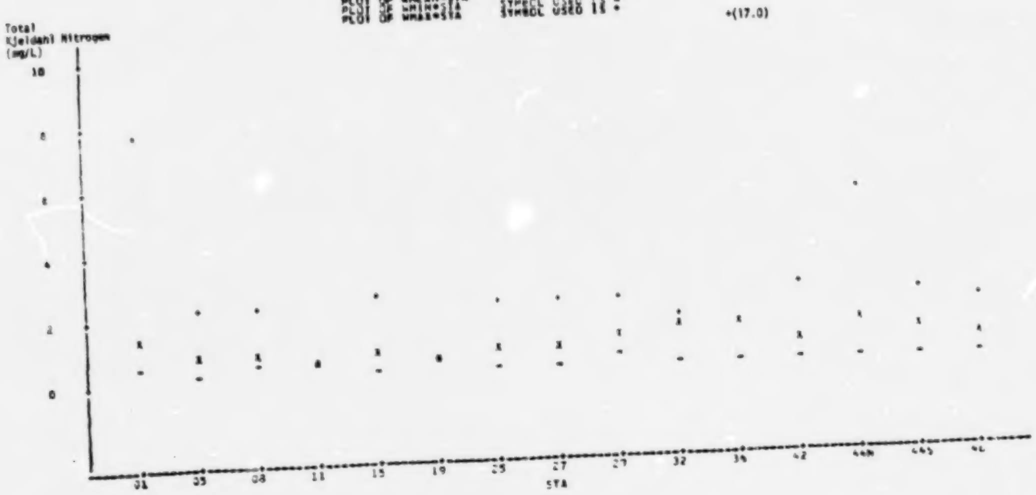
                                                       15:58 FRIDAY, OCTOBER 26, 1984   1
              N. SASK R. 1970-1982
                 WINTER SEASON
     Table A7.6  Total Kjeldahl Nitrogen (mg/L)
PLOT OF WMEAN*STA     SYMBOL USED IS X
PLOT OF WMIN*STA      SYMBOL USED IS -
PLOT OF WMAX*STA      SYMBOL USED IS +
```



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                                                       15:58 FRIDAY, OCTOBER 26, 1984   2
              N. SASK R. 1970-1982
                 SUMMER SEASON
     Table A7.6  Total Kjeldahl Nitrogen (mg/L)
PLOT OF SMEAN*STA     SYMBOL USED IS X
PLOT OF SMIN*STA      SYMBOL USED IS -
PLOT OF SMAX*STA      SYMBOL USED IS +
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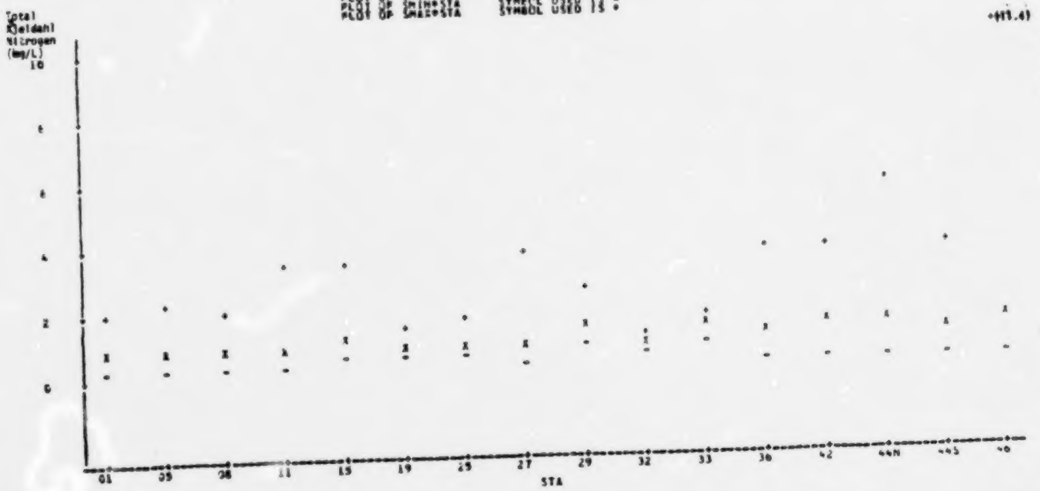
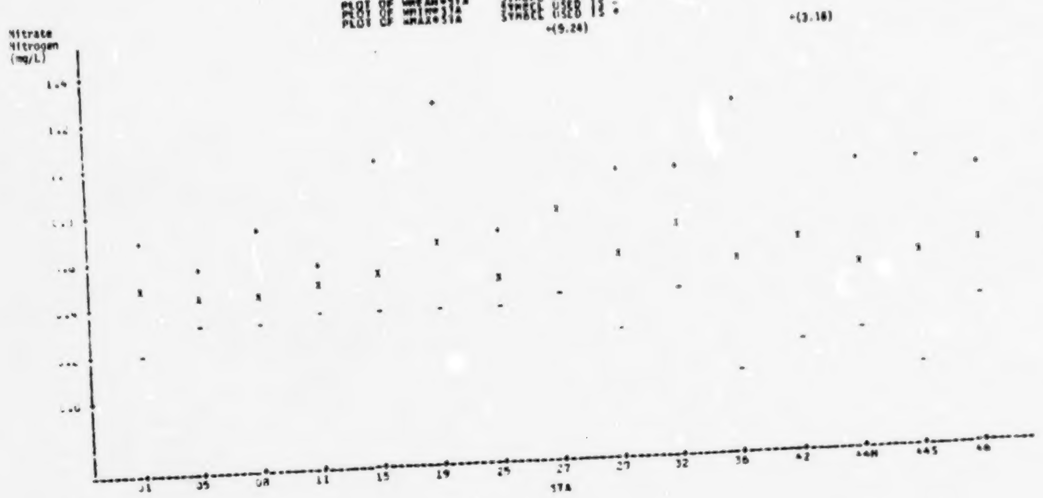


11:48 MONDAY, NOVEMBER 5, 1984 5

N. SASK R. 1970-1982
WINTER SEASON
Table A7.7 Nitrate Nitrogen (mg/L)

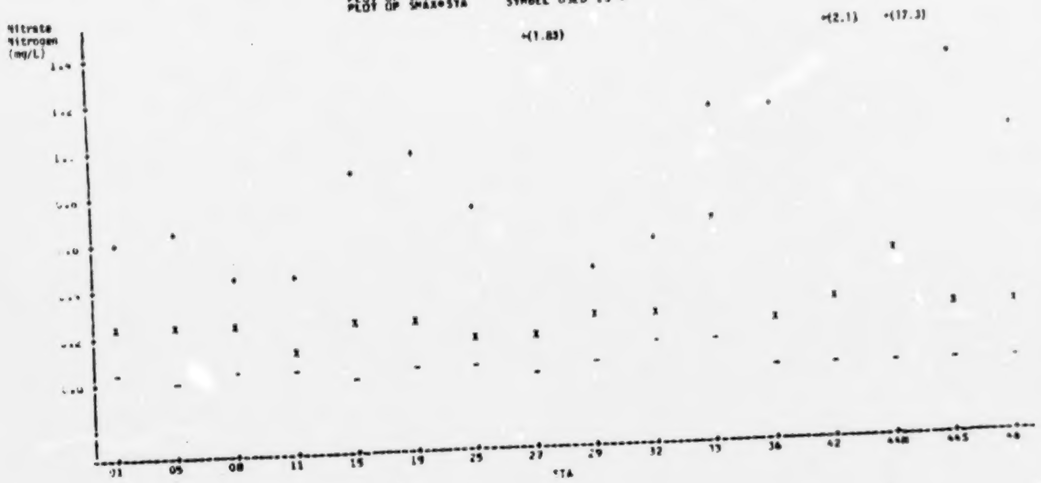
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



11:48 MONDAY, NOVEMBER 5, 1984

N. SASK R. 1970-1982
SUMMER SEASON
Table A7.7 Nitrate Nitrogen (mg/L)

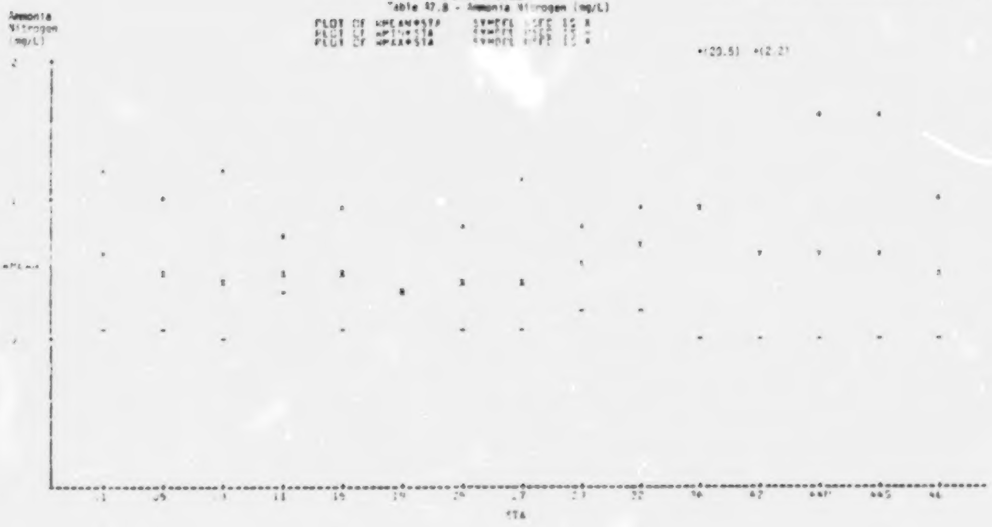
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.8 - Ammonia Nitrogen (mg/L)

16:05 WEDNESDAY, OCTOBER 31, 1984 5

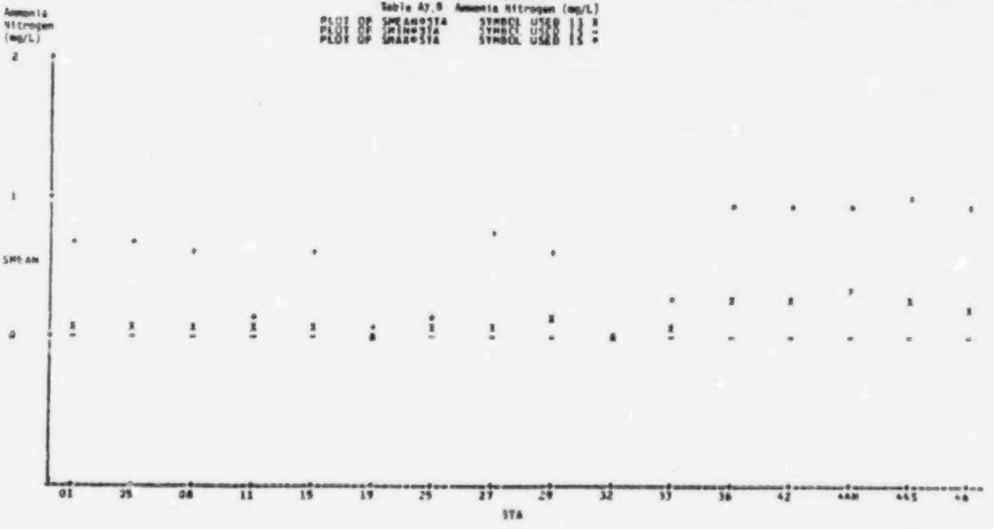
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.9 Ammonia Nitrogen (mg/L)

16:05 WEDNESDAY, OCTOBER 31, 1984 6

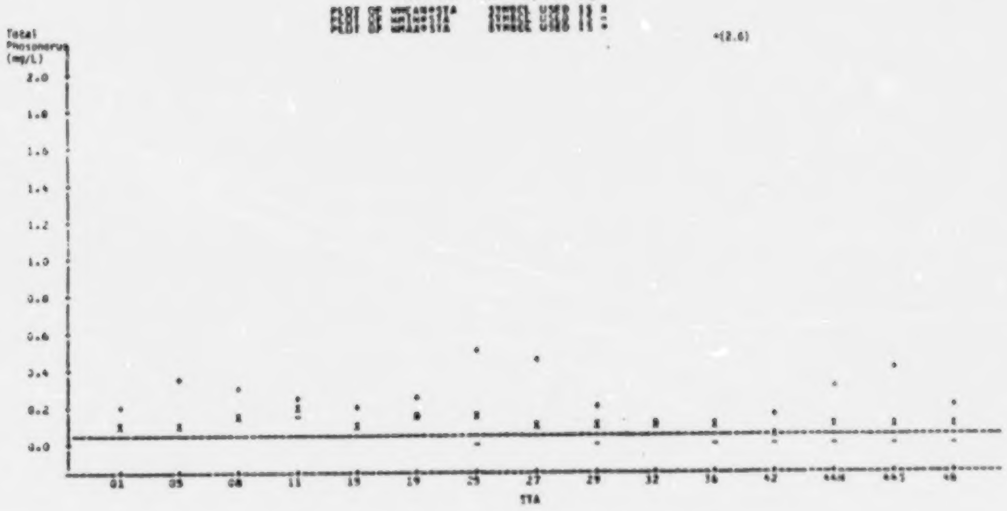
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SAGE R. 1970-1982   9:25 THURSDAY, NOVEMBER 1, 1984   3

WINTER SEASON

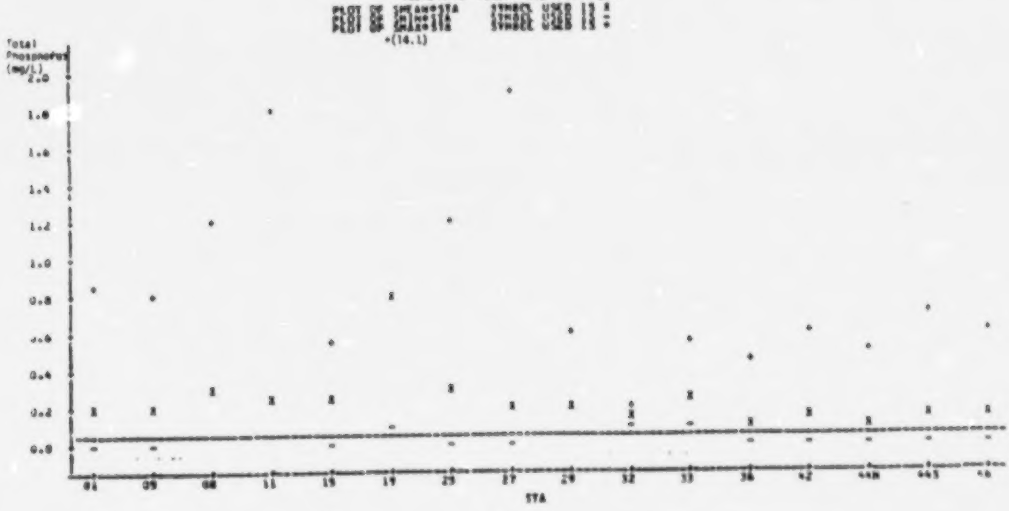
Table A7.9 Total Phosphorus (mg/L)



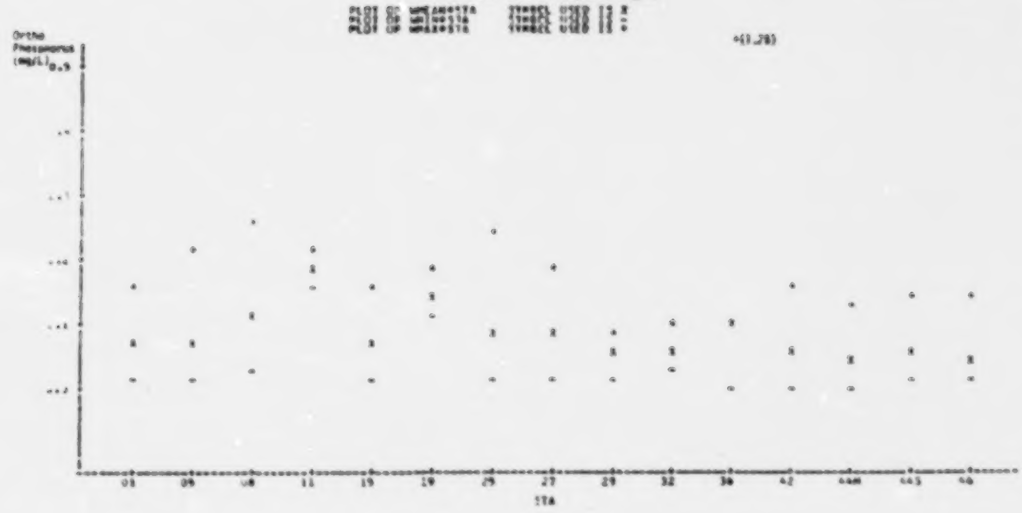
N. SAGE R. 1970-1982   9:25 THURSDAY, NOVEMBER 1, 1984   4

SUMMER SEASON

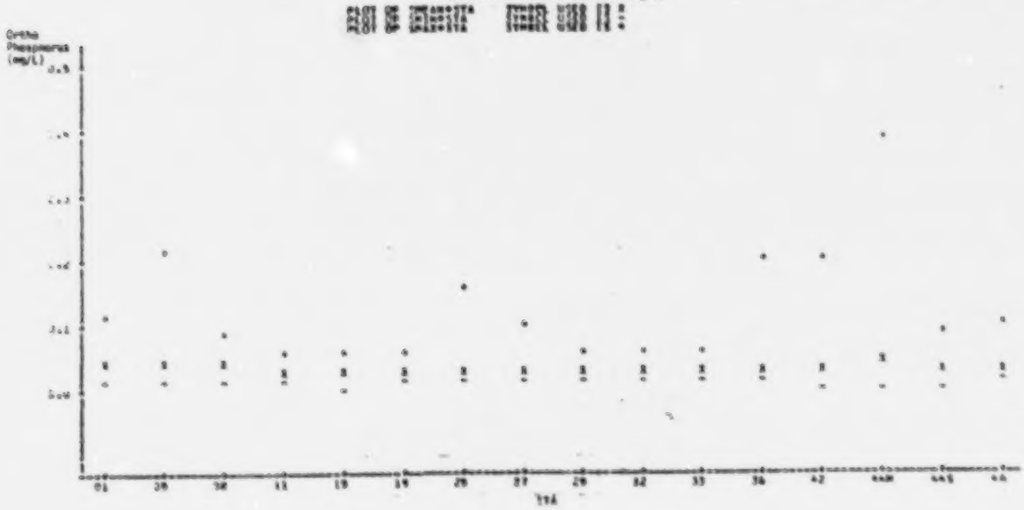
Table A7.9 Total Phosphorus (mg/L)



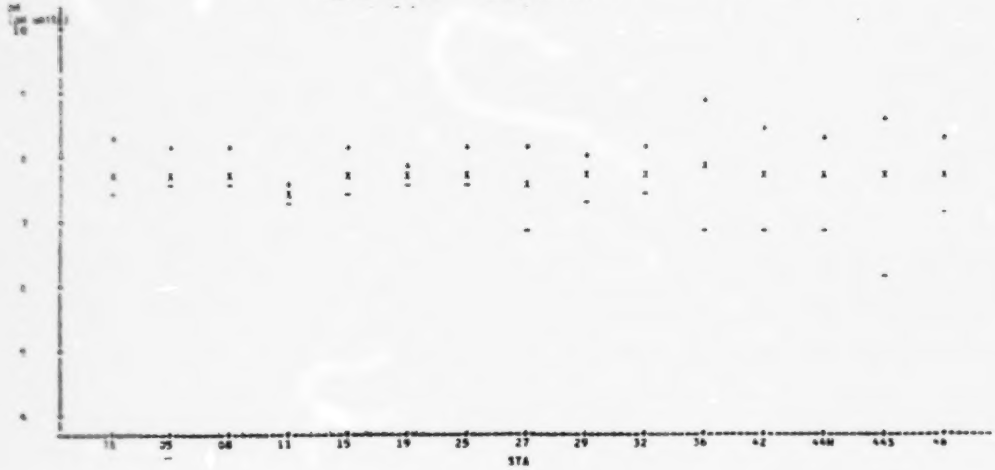
N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984
WINTER SEASON
Table A7.10 Ortho Phosphorus (mg/L)



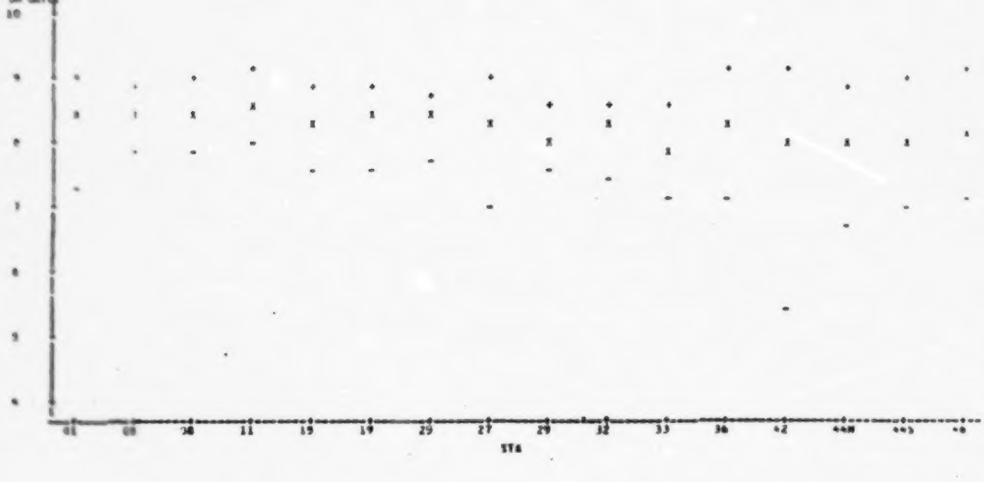
N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984
SUMMER SEASON
Table A7.10 Ortho Phosphorus (mg/L)



[illegible] 1970-1982 8:26 MONDAY, NOVEMBER 26, 1984 1
WINTER SEASON
Table A7.11 pH (pH units)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

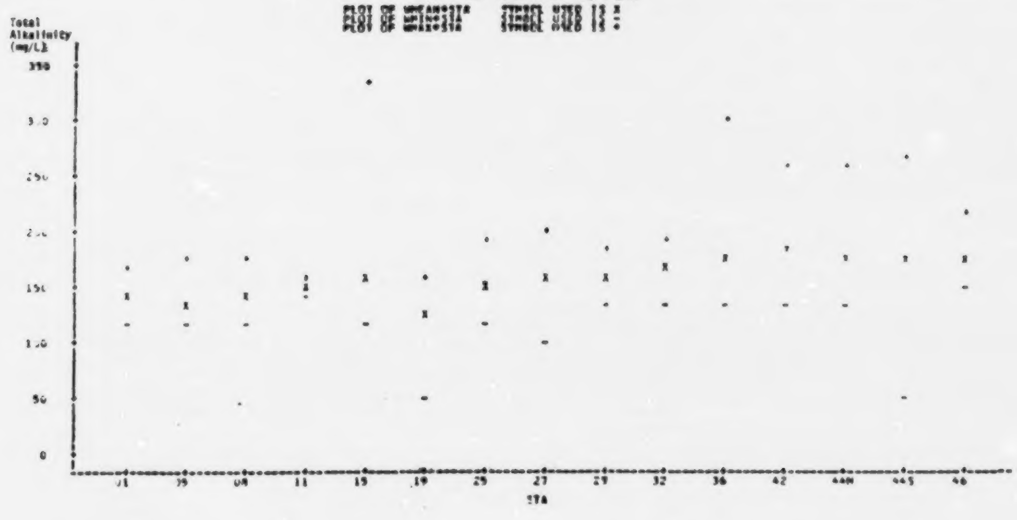


[illegible] 1970-1982 8:26 MONDAY, NOVEMBER 26, 1984 2
SUMMER SEASON
Table A7.11 pH (pH units)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



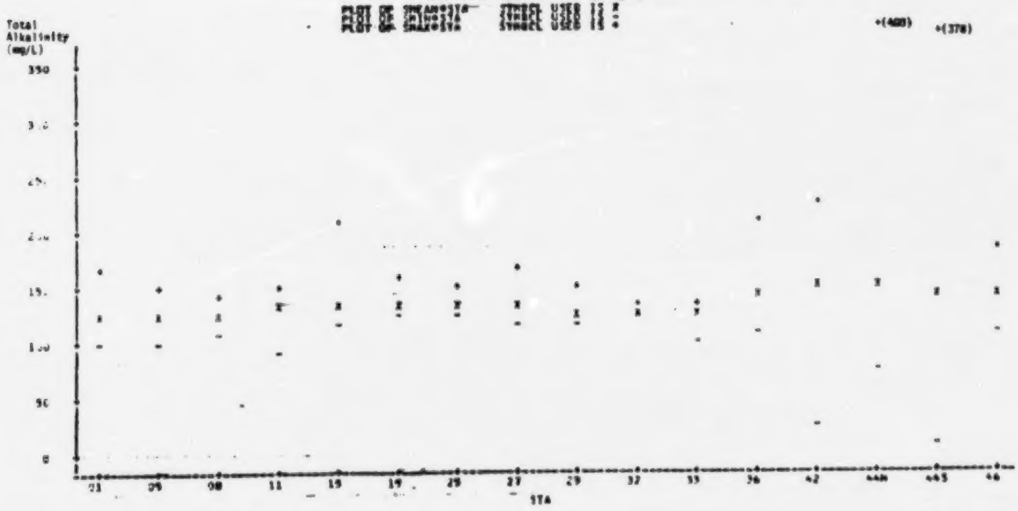
N. SASK R. 1970-1982
WINTER SEASON
Table A7.12 Total Alkalinity (mg/L)

11:48 MONDAY, NOVEMBER 5, 1984 15



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.12 Total Alkalinity (mg/L)

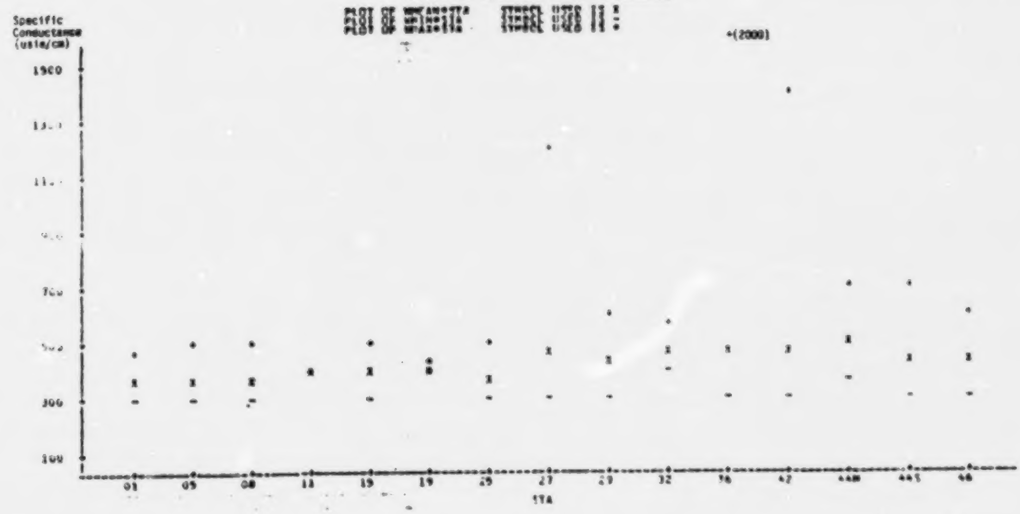
11:48 MONDAY, NOVEMBER 5, 1984 16



N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984

WINTER SEASON

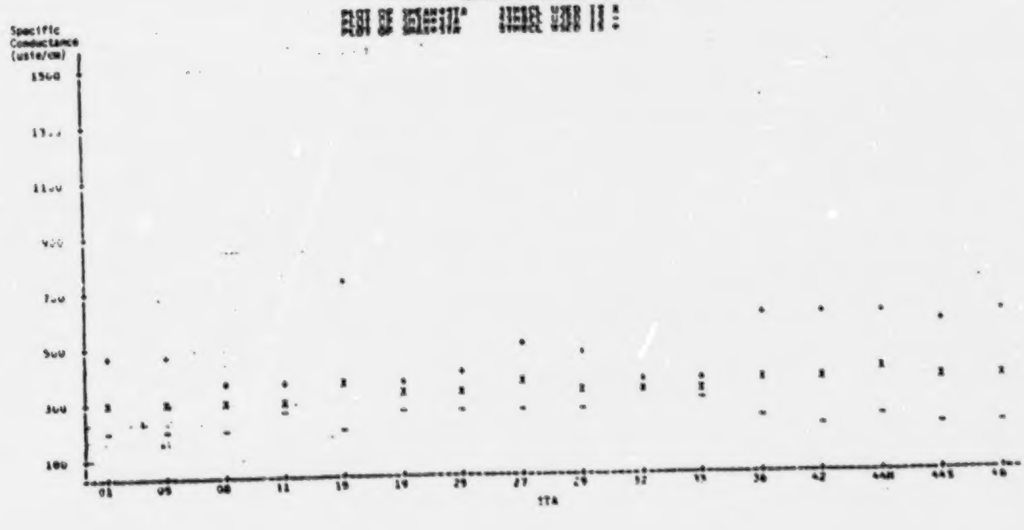
Table A7.12 Specific Conductance (usie/cm)



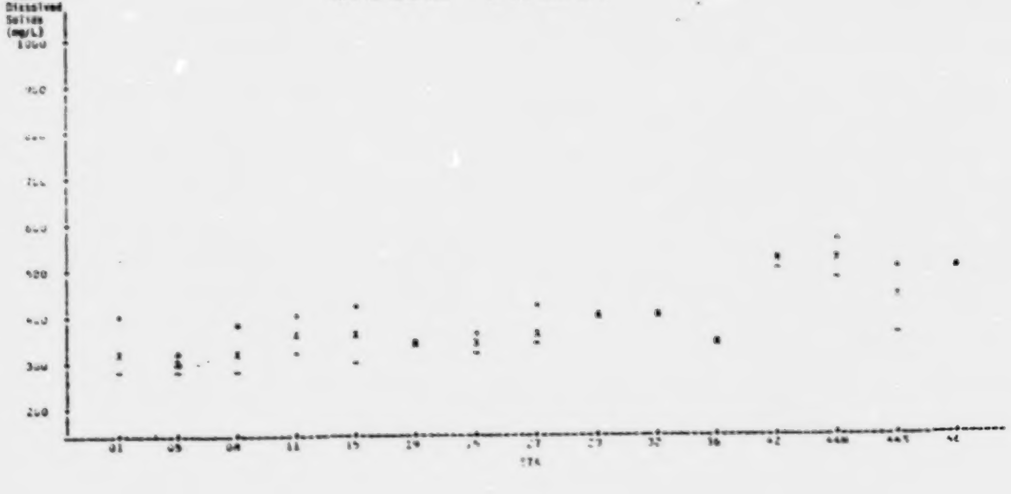
N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984

SUMMER SEASON

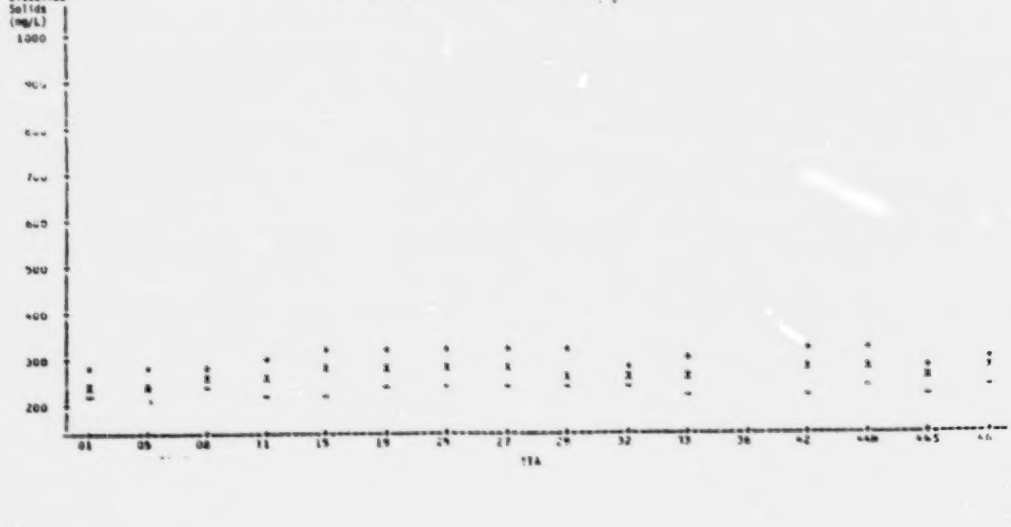
Table A7.13 Specific Conductance (usie/cm)



N. SASK R. 1970-1982 14:00 MONDAY, NOVEMBER 26, 1984 1
WINTER SEASON
Table A7.14 Total Dissolved Solids (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



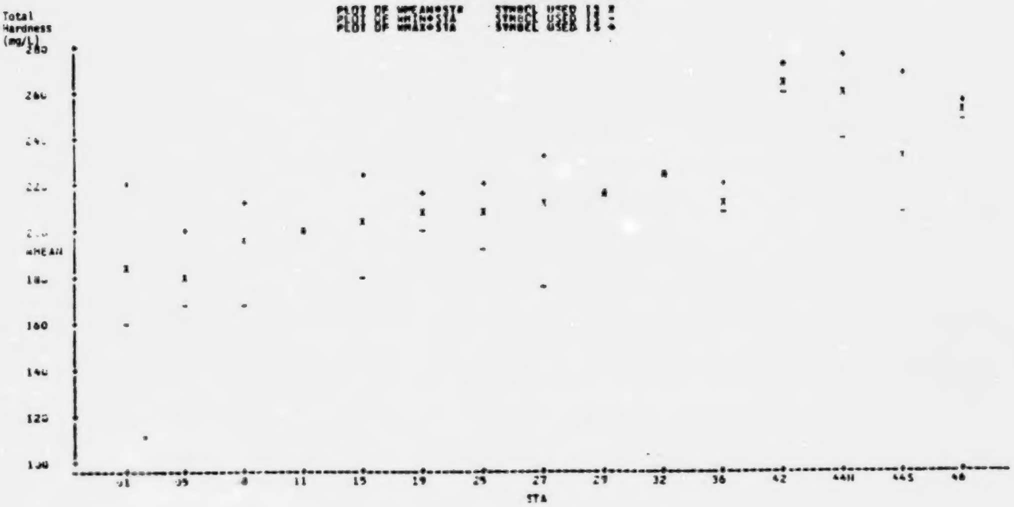
N. SASK R. 1970-1982 14:00 MONDAY, NOVEMBER 26, 1984 2
SUMMER SEASON
Table A7.14 Total Dissolved Solids (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.15 Total Hardness (mg/L)

11:48 MONDAY, NOVEMBER 5, 1984 1.

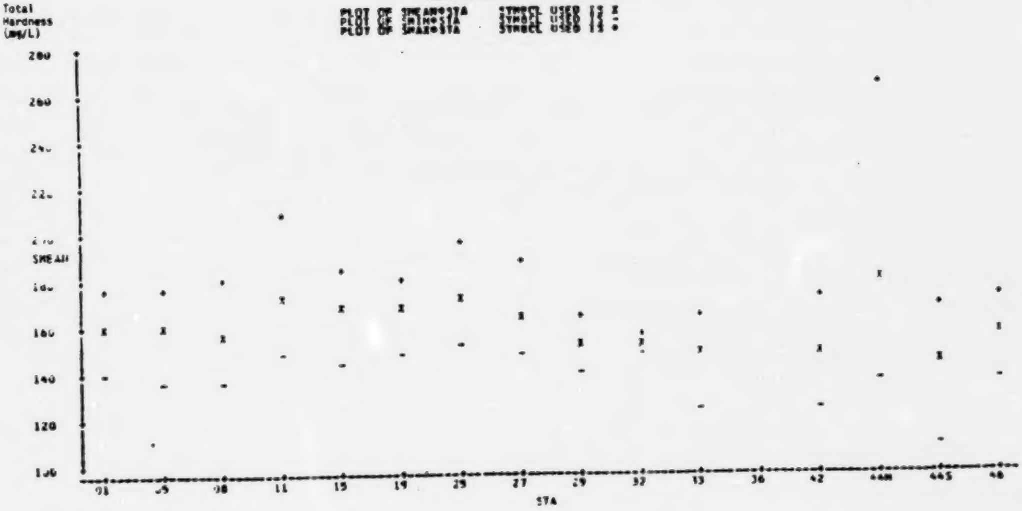
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



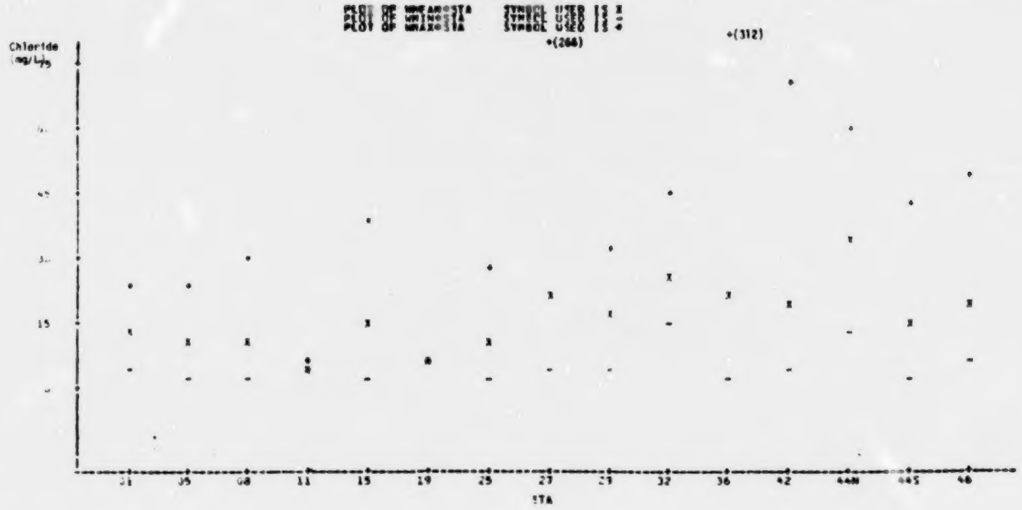
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.15 Total Hardness (mg/L)

11:49 MONDAY, NOVEMBER 5, 1984 16

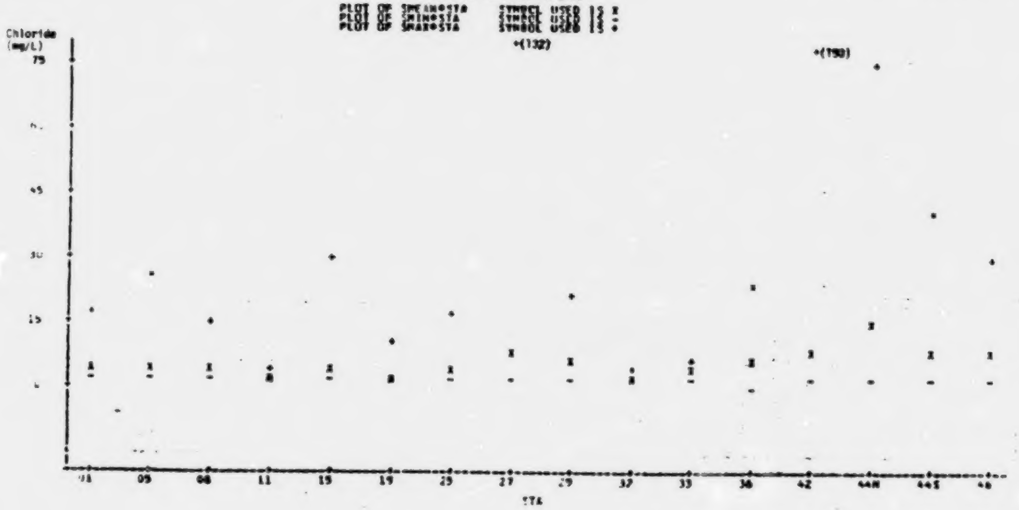
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



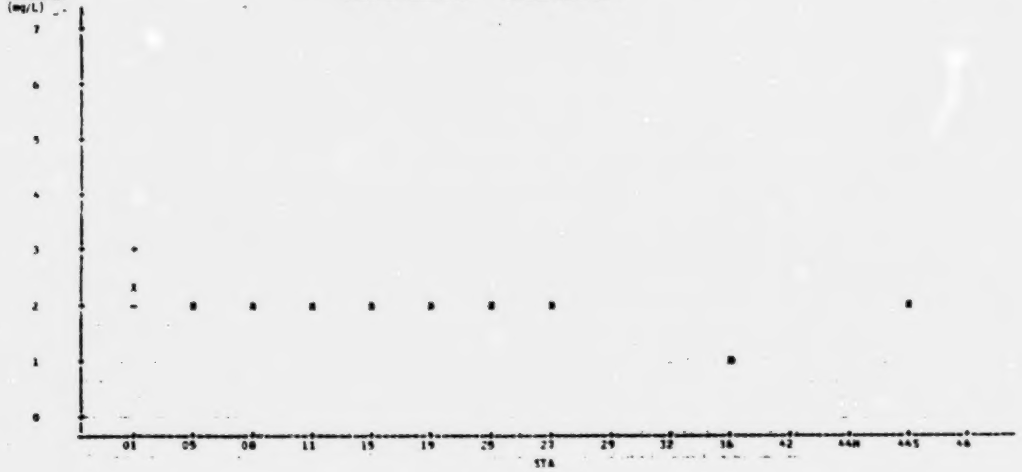
N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984 3
WINTER SEASON
Table A7.16 Chloride (mg/L)



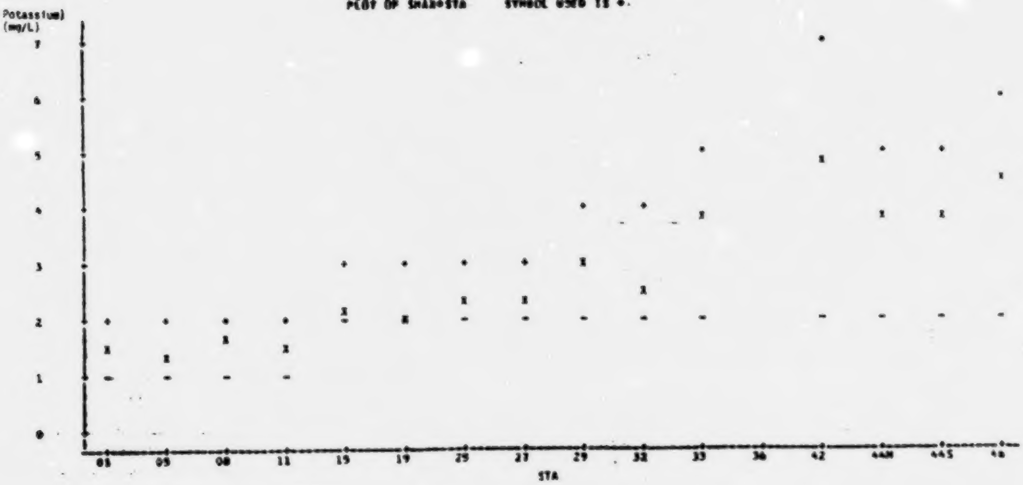
N. SASK R. 1970-1982 11:48 MONDAY, NOVEMBER 5, 1984 4
SUMMER SEASON
Table A7.16 Chloride (mg/L)



N. SASK R. 1970-1982 13:48 THURSDAY, NOVEMBER 1, 1984
WINTER SEASON
Table A7.17 Potassium (mg/L)
PLOT OF MMEAN*STA SYMBOL USED IS X
PLOT OF MMIN*STA SYMBOL USED IS -
PLOT OF MMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 13:48 THURSDAY, NOVEMBER 1, 1984
SUMMER SEASON
Table A7.17 Potassium (mg/L)
PLOT OF MMEAN*STA SYMBOL USED IS X
PLOT OF MMIN*STA SYMBOL USED IS -
PLOT OF MMAX*STA SYMBOL USED IS +



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                    N. SASK R. 1970-1982                                 11:48 MONDAY, NOVEMBER 5, 1984   13
                      WINTER SEASON
                    Table A7.18  Sodium (mg/L)
PLOT OF WMEAN*STA     SYMBOL USED IS X
PLOT OF WMIN*STA      SYMBOL USED IS -
PLOT OF WMAX*STA      SYMBOL USED IS +
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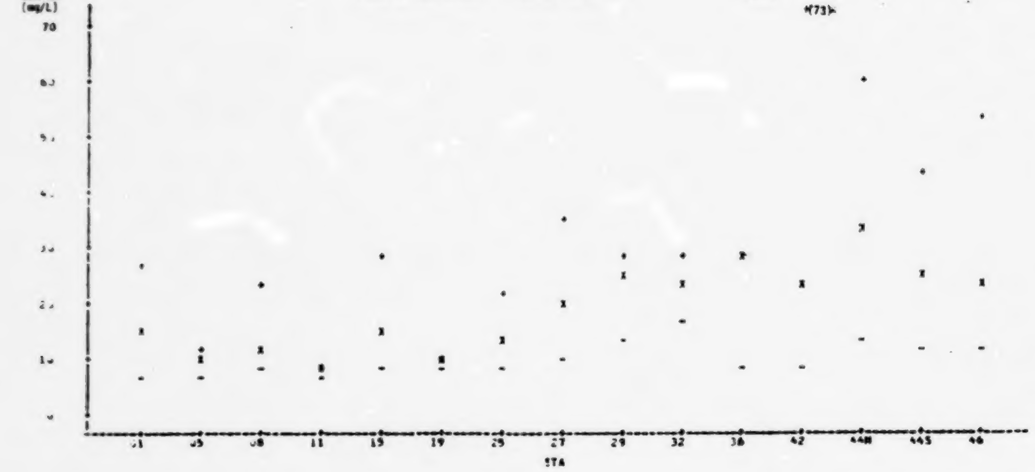

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                    N. SASK R. 1970-1982                                 11:48 MONDAY, NOVEMBER 5, 1984   14
                      SUMMER SEASON
                    Table A7.18  Sodium (mg/L)
PLOT OF SMEAN*STA     SYMBOL USED IS X
PLOT OF SMIN*STA      SYMBOL USED IS -
PLOT OF SMAX*STA      SYMBOL USED IS +
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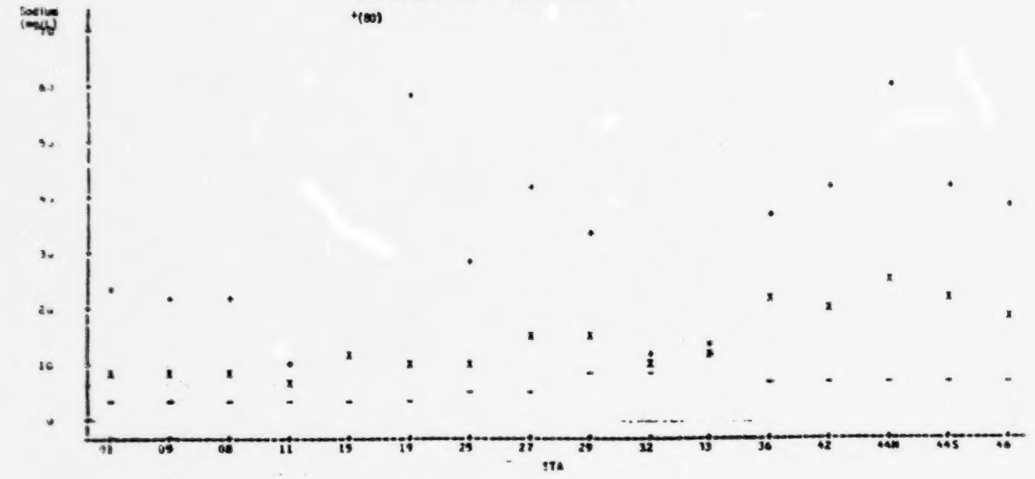
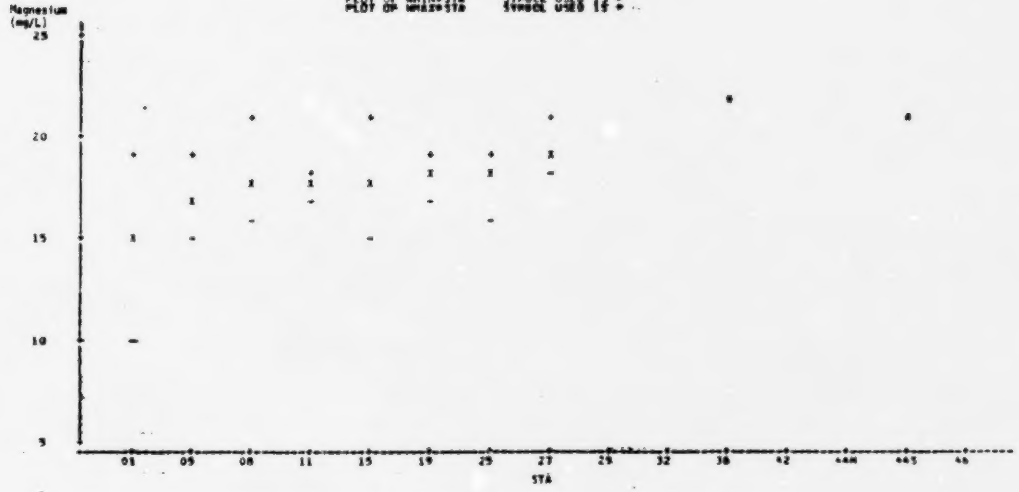


N. SASK R. 1970-1982
WINTER SEASON
Table A7.19 Magnesium (mg/L)

13:48 THURSDAY, NOVEMBER 1, 1984 7

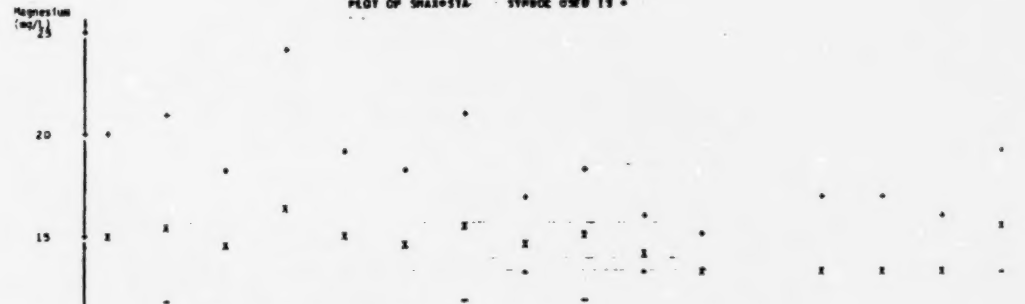
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



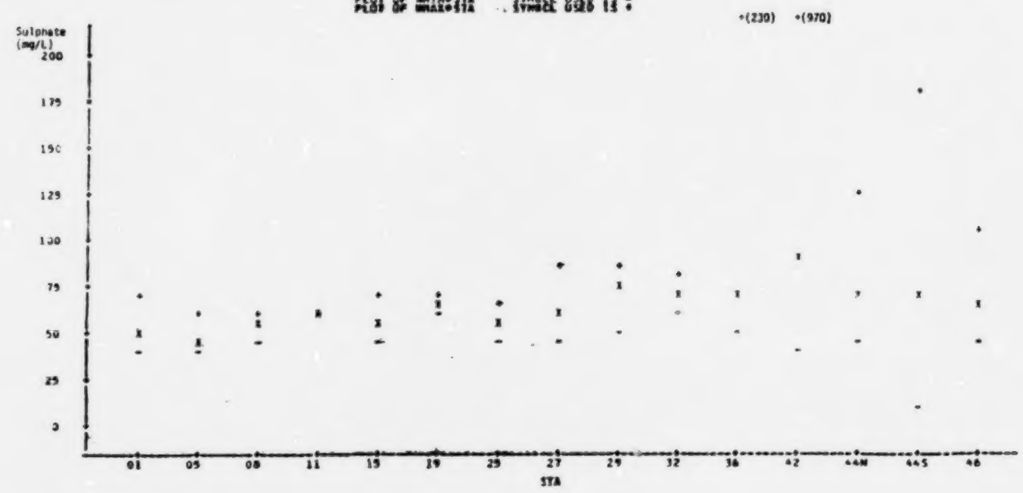
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.19 Magnesium (mg/L)

13:48 THURSDAY, NOVEMBER 1, 1984

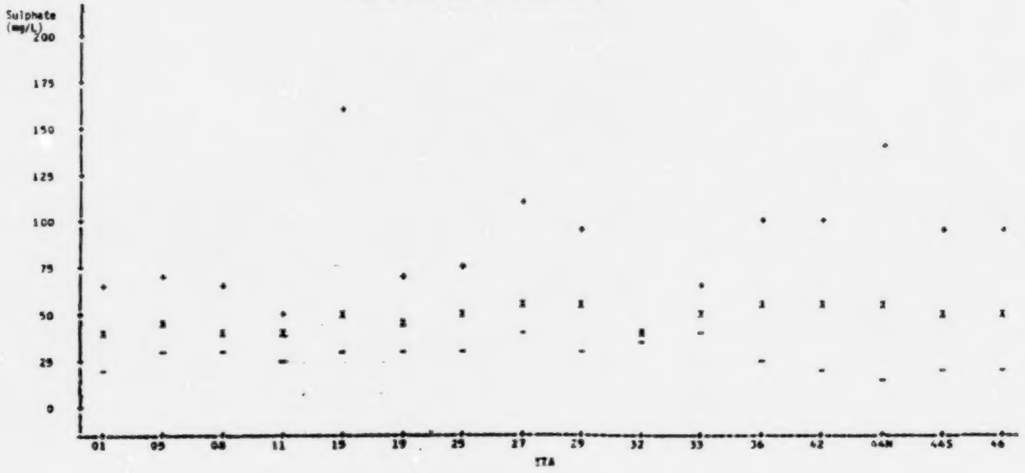
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982   13:48 THURSDAY, NOVEMBER 1, 1984   1
WINTER SEASON
Table A7.29 Sulphate (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982   13:48 THURSDAY, NOVEMBER 1, 1984   1a
SUMMER SEASON
Table A7.30 Sulphate (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



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                N. SASK R. 1970-1982                    13:48 THURSDAY, NOVEMBER 1, 1984
                   WINTER SEASON
               Table A7.21 Calcium (mg/L)
        PLOT OF WMEAN*STA    SYMBOL USED IS X
        PLOT OF WMIN*STA     SYMBOL USED IS -
        PLOT OF WMAX*STA     SYMBOL USED IS +
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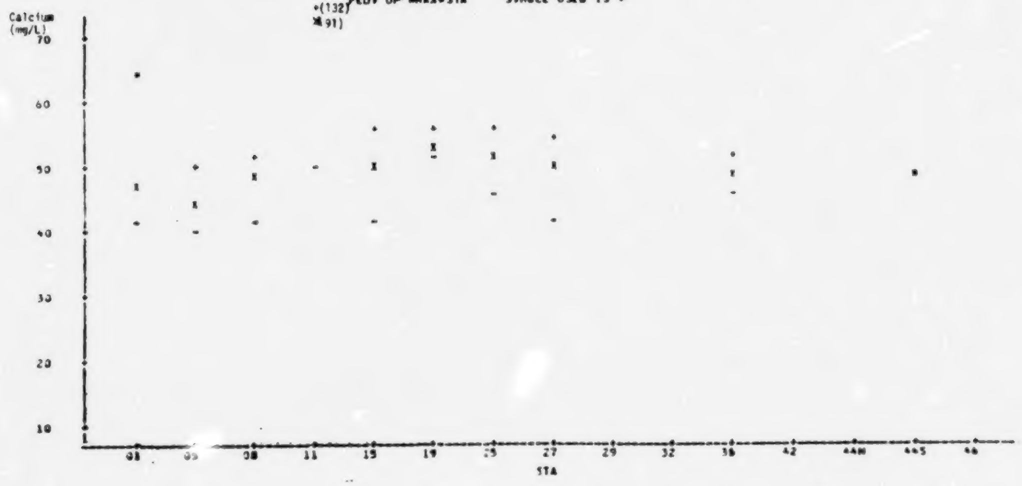

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                N. SASK R. 1970-1982                    13:48 THURSDAY, NOVEMBER 1, 1984   10
                   SUMMER SEASON
               Table A7.21 Calcium (mg/L)
        PLOT OF SMEAN*STA    SYMBOL USED IS X
        PLOT OF SMIN*STA     SYMBOL USED IS -
        PLOT OF SMAX*STA     SYMBOL USED IS +
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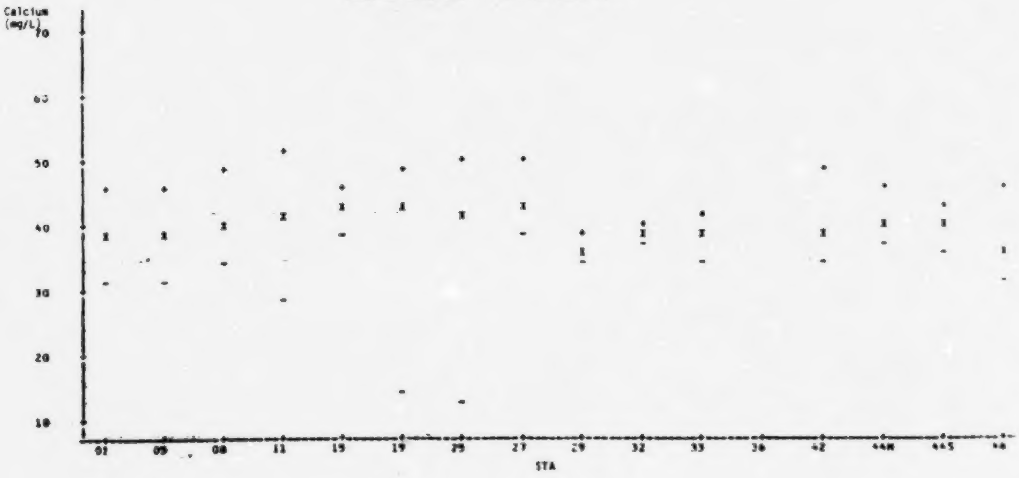
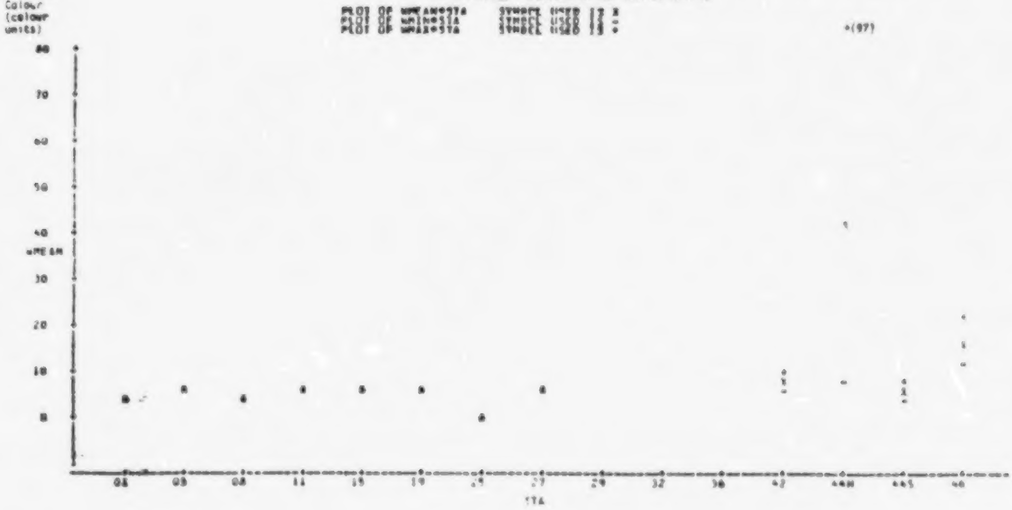


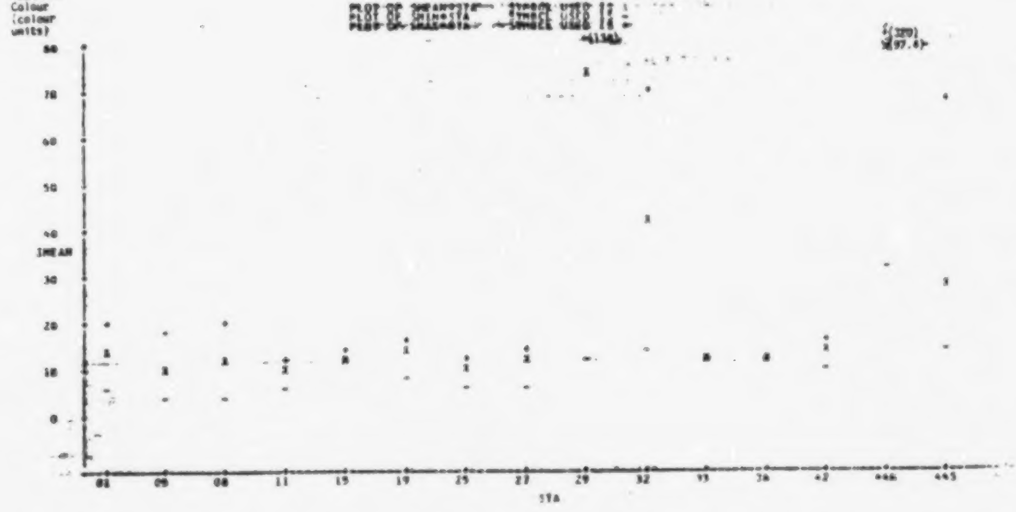
N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984
WINTER SEASON
Table A7.22 Apparent Colour (colour units)

PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984
SUMMER SEASON
Table A7.22 Apparent Colour (colour units)

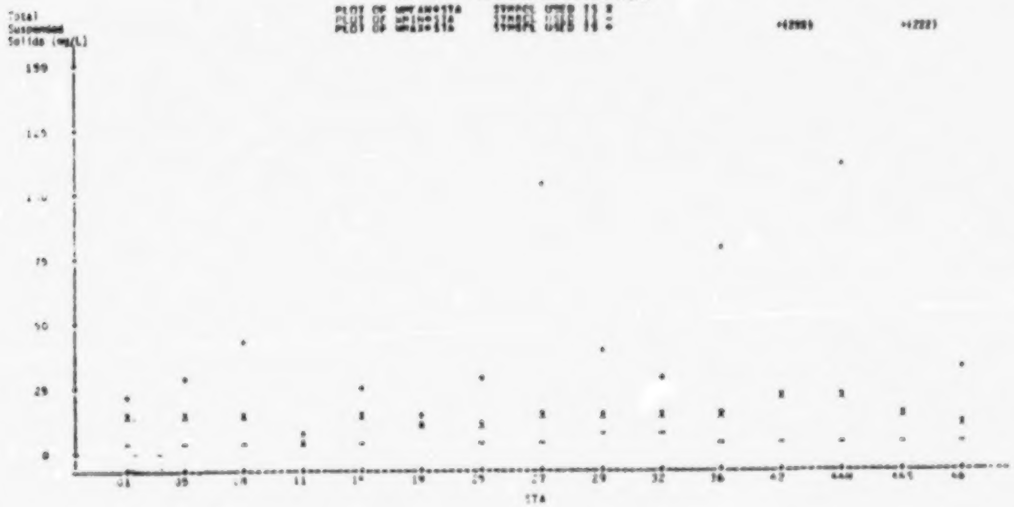
PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 11:40 MONDAY, NOVEMBER 5, 1984 7

WINTER SEASON

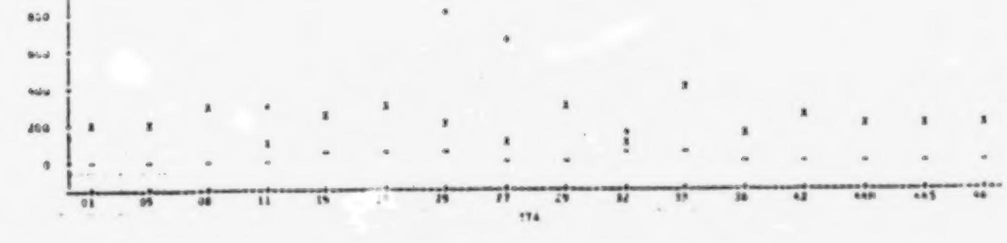
Table A7.23 Total Suspended Solids (mg/L)



N. SASK R. 1970-1982 11:40 MONDAY, NOVEMBER 5, 1984 8

SUMMER SEASON

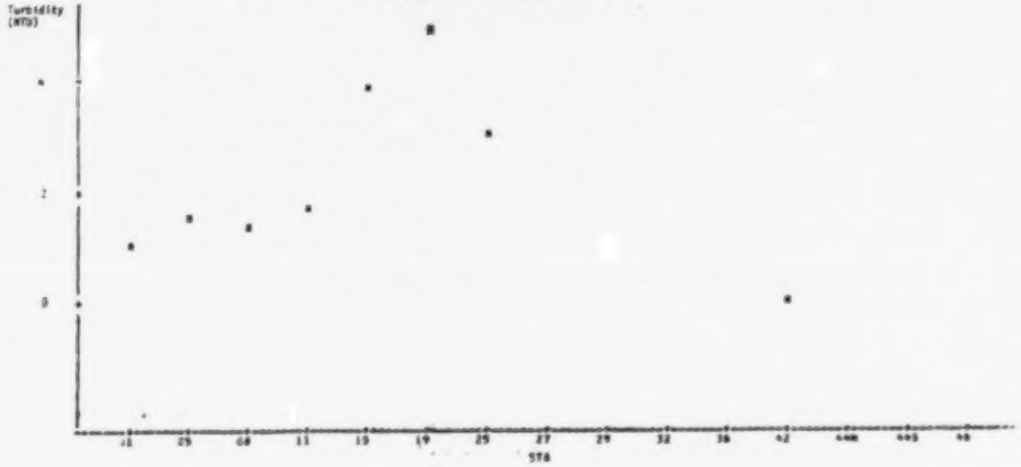
Table A7.23 Total Suspended Solids (mg/L)



[illegible] 1970-1982   [illegible] MONDAY, NOVEMBER 26, 1984   5

Table A7.26 Turbidity (NTU)

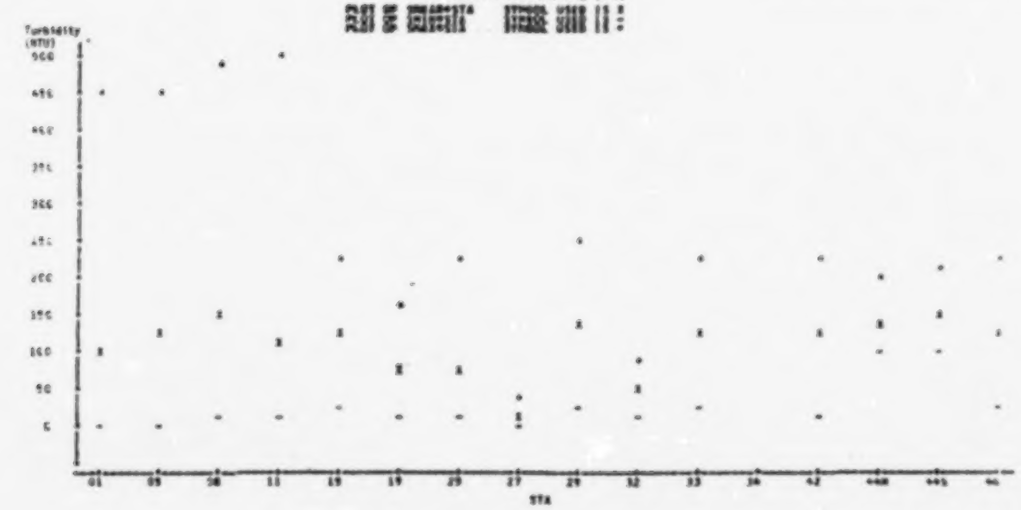
[illegible]



[illegible] 1970-1982   [illegible] MONDAY, NOVEMBER 26, 1984   6

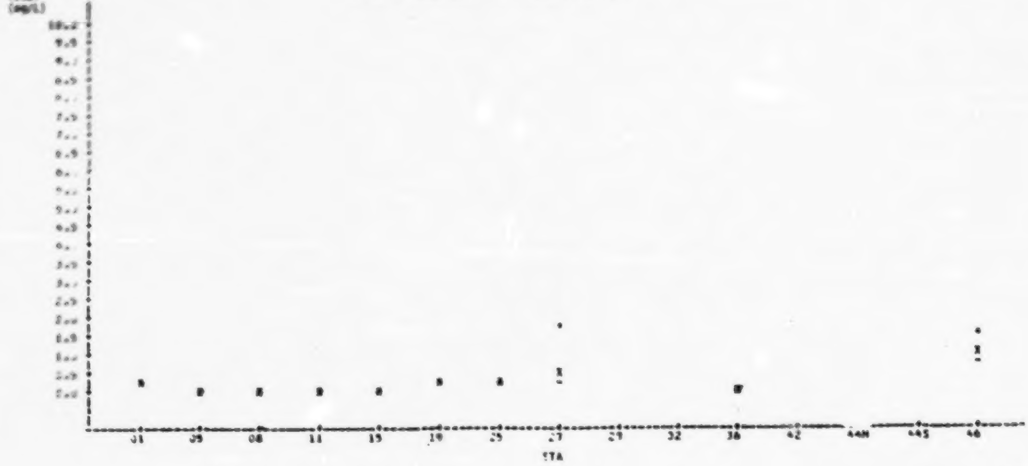
Table A7.26 Turbidity (NTU)

[illegible]



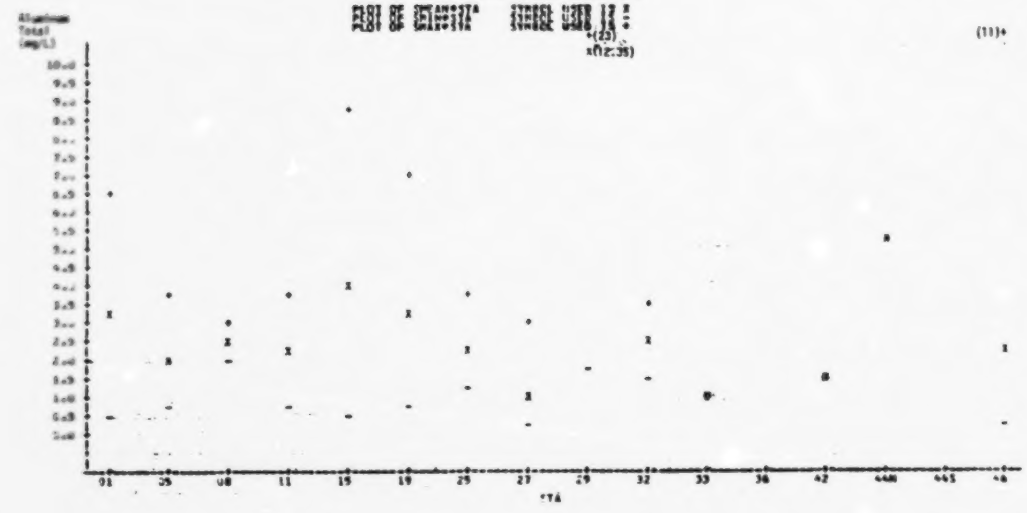
N. SASK R. 1970-1982
WINTER SEASON
Table A7.25 Aluminum Total (mg/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

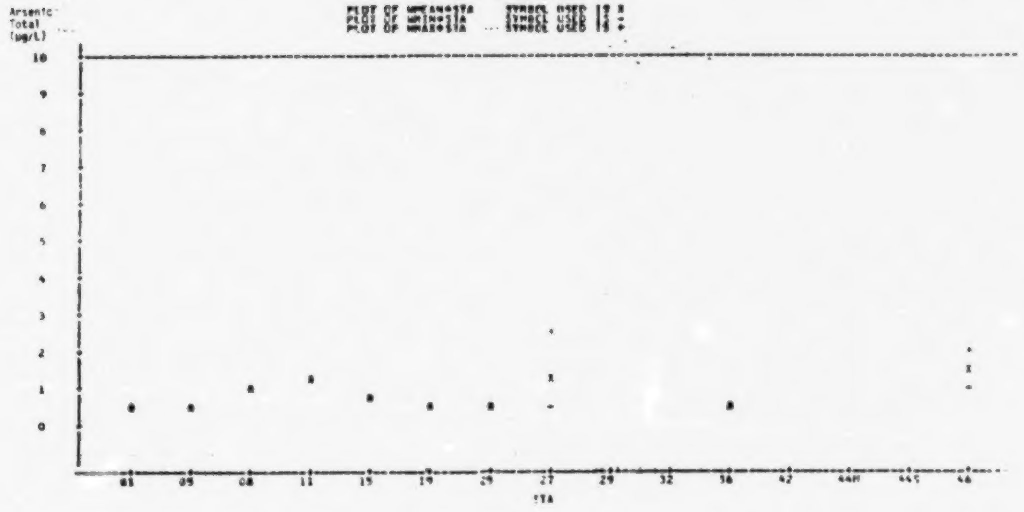


N. SASK R. 1970-1982
SUMMER SEASON
Table A7.25 Aluminum Total (mg/L)

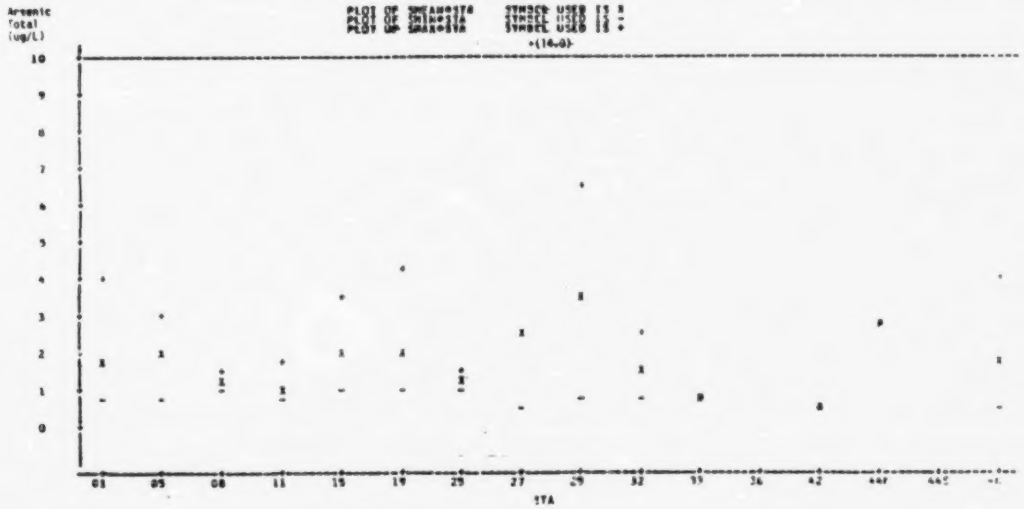
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.26 Arsenic total (ug/L)



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.26 Arsenic Total (ug/L)

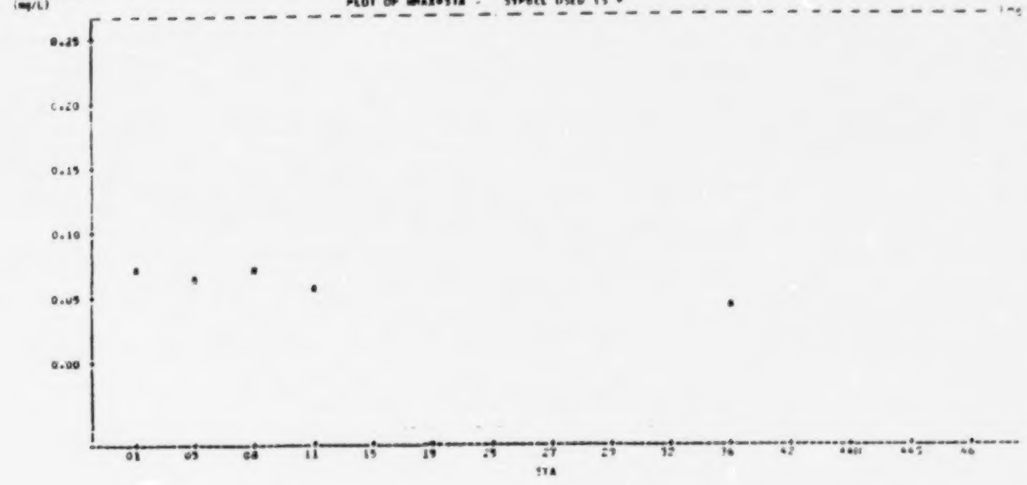


N. SASK R. 1970-1982   9:11 WEDNESDAY, NOVEMBER 14, 1984 1

WINTER SEASON

Table A7.27 Barium Total (mg/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

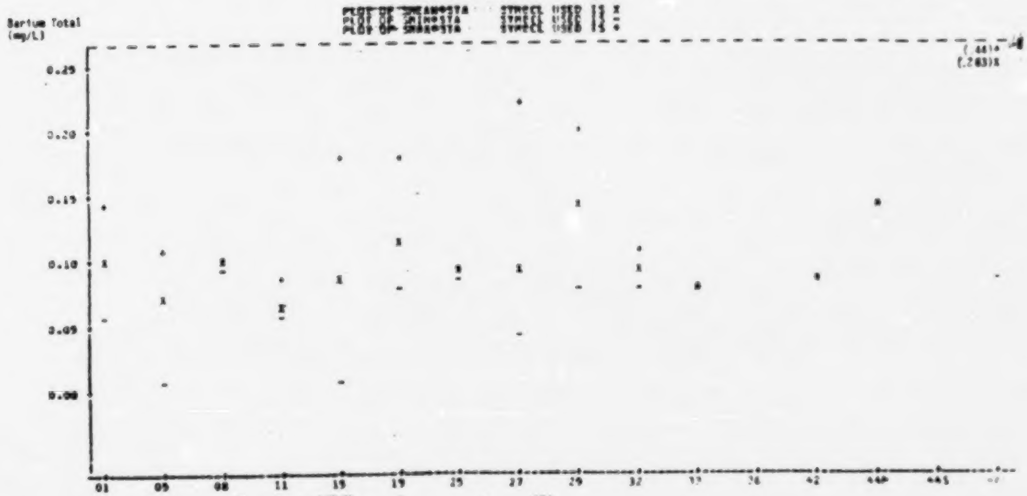


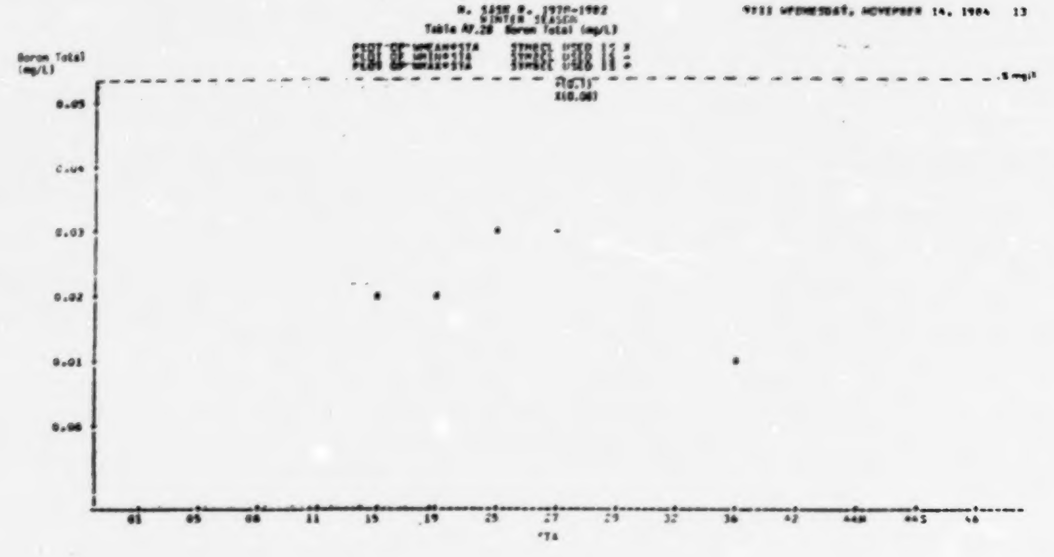
N. SASK R. 1970-1982   9:11 WEDNESDAY, NOVEMBER 14, 1984 12

SUMMER SEASON

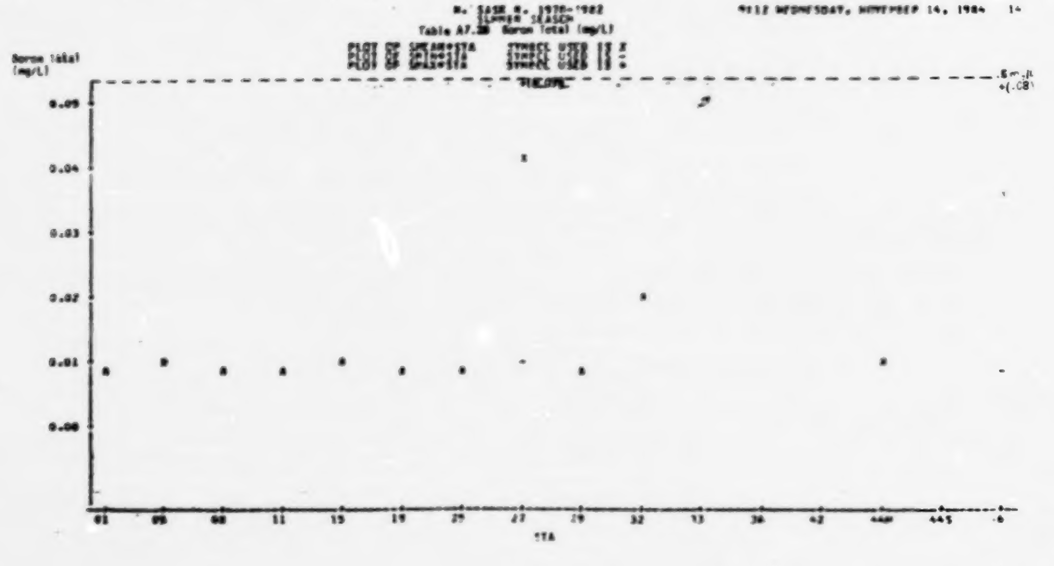
Table A7.27 Barium Total (mg/L)

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +




N. SASK R. 1970-1982
WINTER SEASON
Table A7.28 Boron Total (mg/L)

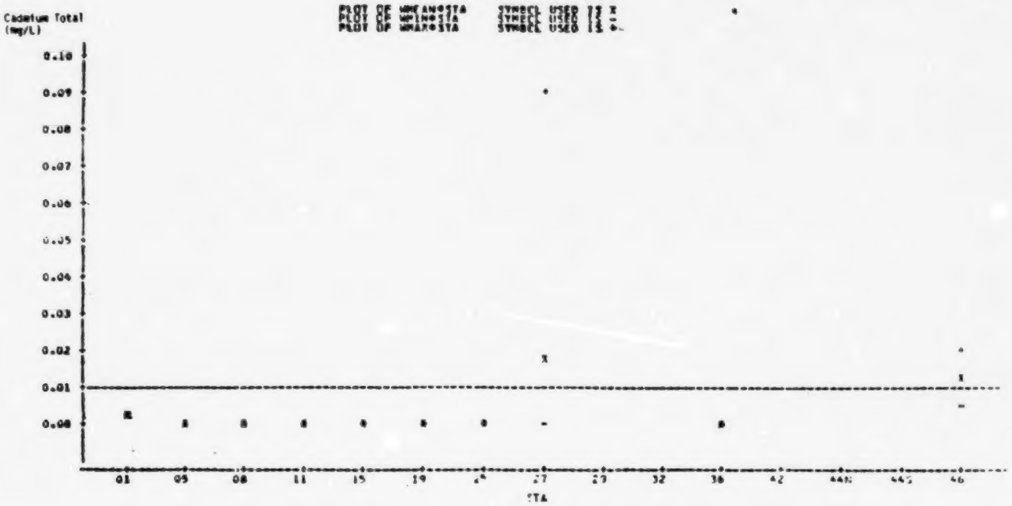
9:11 WEDNESDAY, NOVEMBER 14, 1984 13


N. SASK R. 1970-1982
SUMMER SEASON
Table A7.28 Boron Total (mg/L)

9:12 WEDNESDAY, NOVEMBER 14, 1984 14

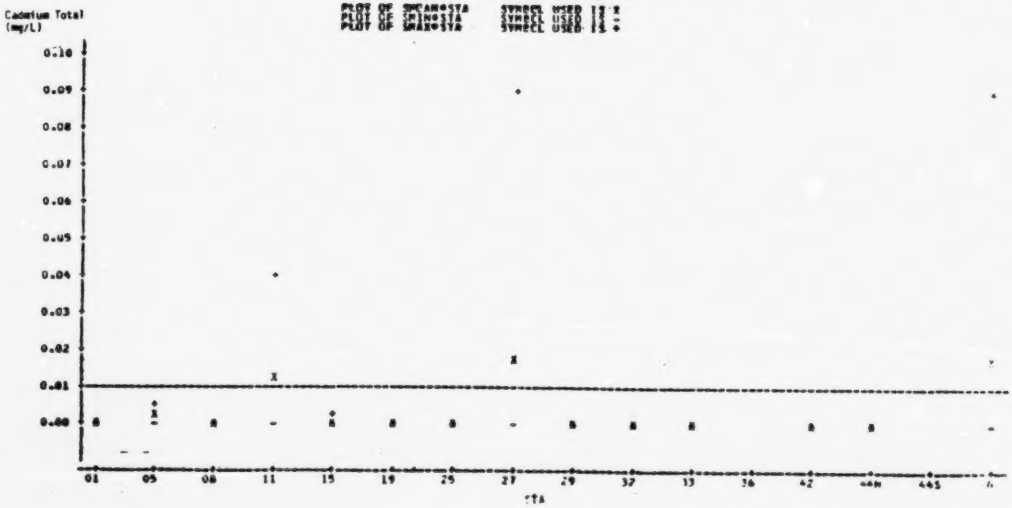
N. SASK R. 1970-1982
WINTER SEASON
Table A7.29 Cadmium Total (mg/L)

11 WEDNESDAY, NOVEMBER 14, 1984



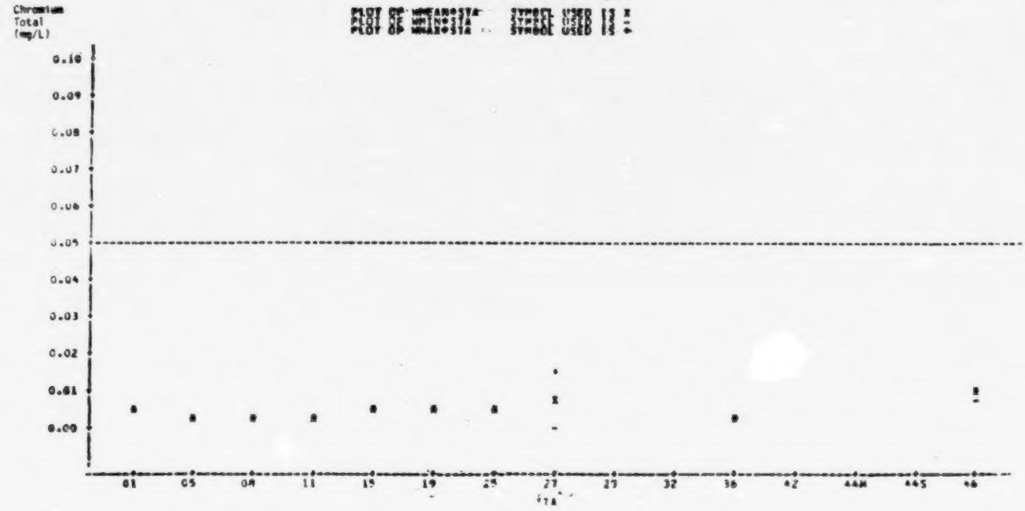
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.29 Cadmium Total (mg/L)

11 WEDNESDAY, NOVEMBER 14, 1984



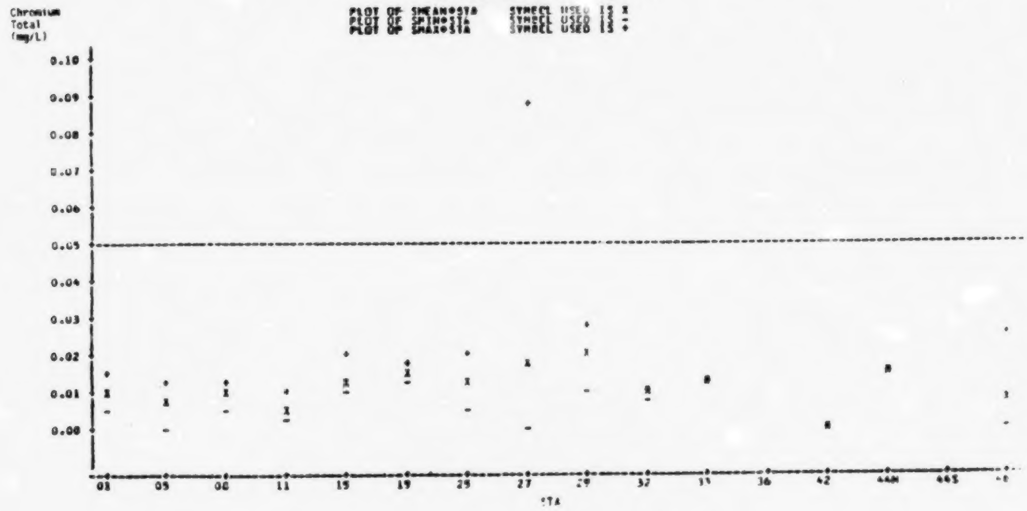
N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984 1
WINTER SEASON
Table A7.30 Chromium Total (mg/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984 18
SUMMER SEASON
Table A7.30 Chromium Total (mg/L)

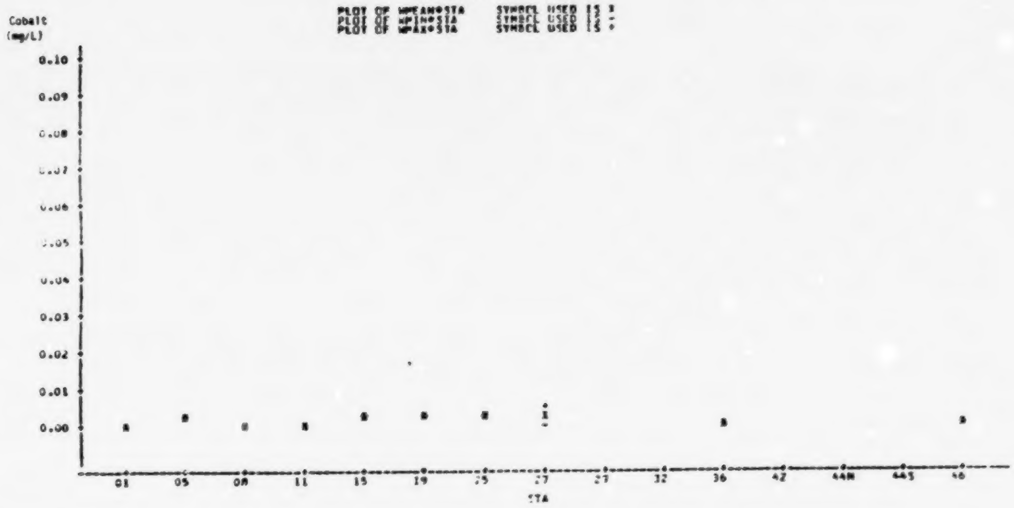
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.31. Cobalt (mg/L)

9:11 WEDNESDAY, NOVEMBER 14, 1984 1

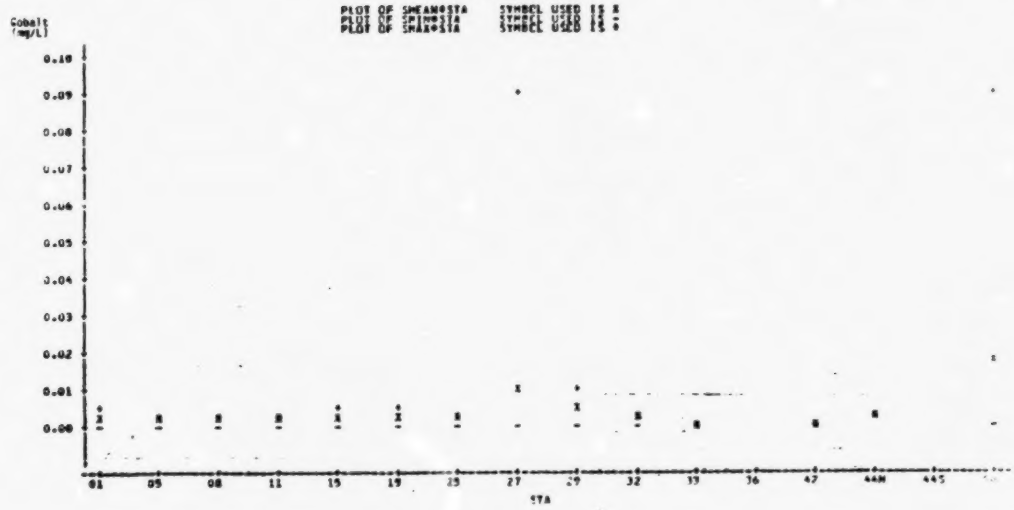
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.31 Cobalt (mg/L)

9:11 WEDNESDAY, NOVEMBER 14, 1984 2

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



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                 N. SASK R. 1970-1982                         [illegible] WEDNESDAY, NOVEMBER 14, 1984   2
                   WINTER SEASON
           Table A7.32  Copper Total (mg/L)
PLOT OF WMEAN*STA     SYMBOL USED IS X
PLOT OF WMIN*STA      SYMBOL USED IS -
PLOT OF WMAX*STA      SYMBOL USED IS +
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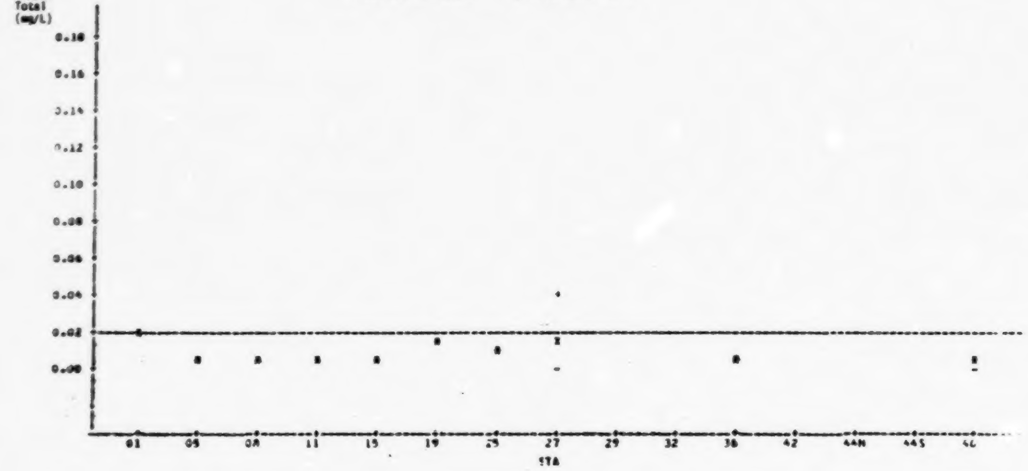

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                 N. SASK R. 1970-1982                         [illegible] WEDNESDAY, NOVEMBER 14, 1984   2
                   SUMMER SEASON
           Table A7.32  Copper Total (mg/L)
PLOT OF SMEAN*STA     SYMBOL USED IS X
PLOT OF SMIN*STA      SYMBOL USED IS -
PLOT OF SMAX*STA      SYMBOL USED IS +
```
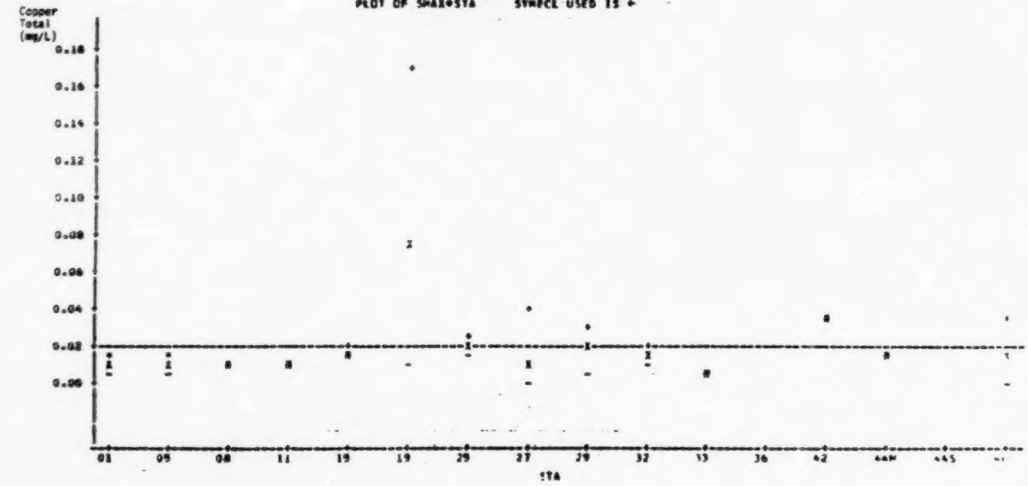
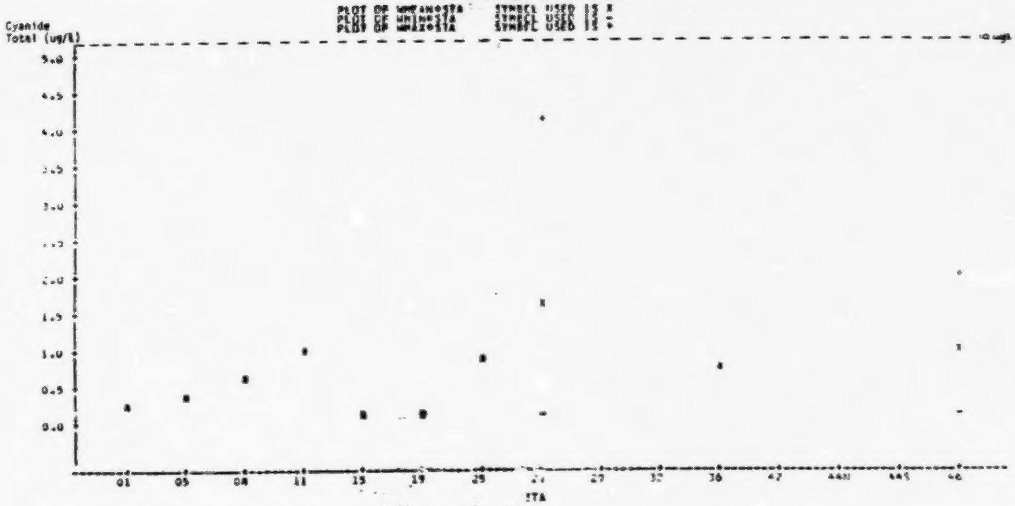



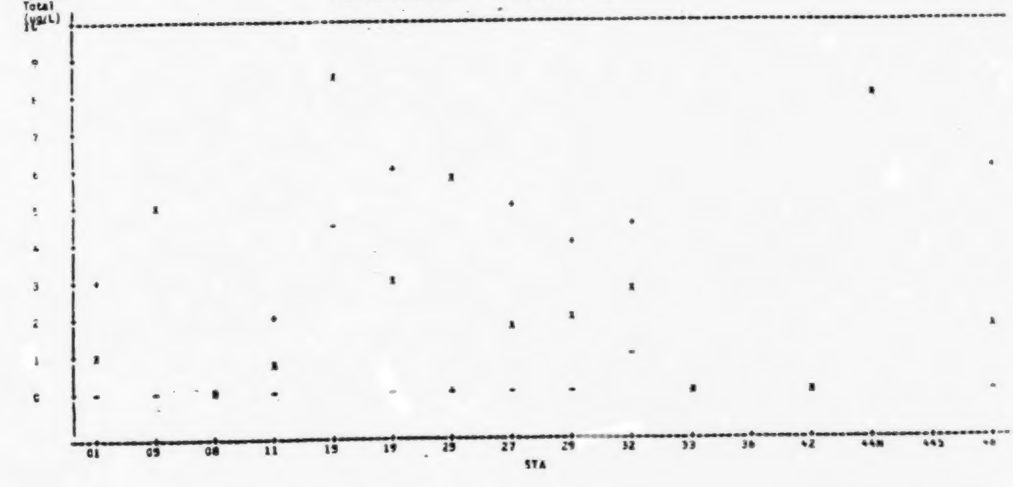
N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984 23
WINTER SEASON
Table A7.33 Cyanide Total (ug/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

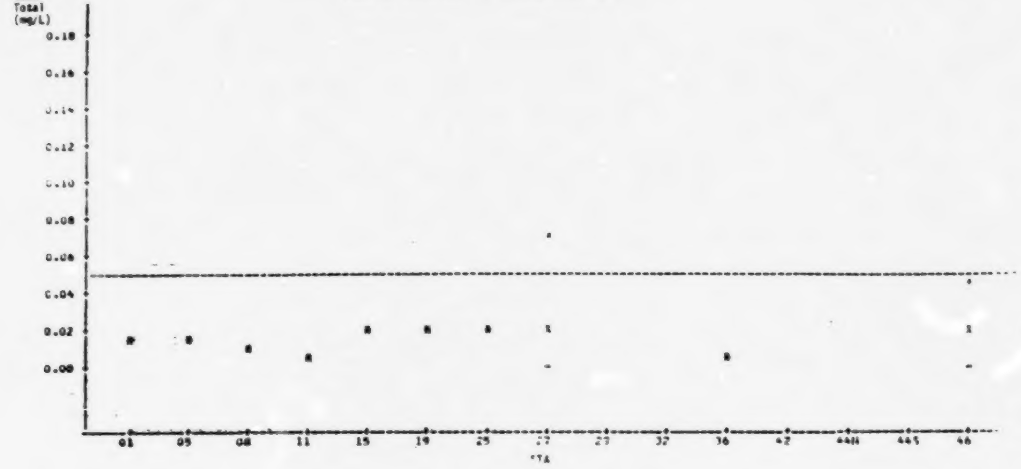


N. SASK R. 1970-1982 12:59 THURSDAY, NOVEMBER 15, 1984 17
SUMMER SEASON
Table A7.33 Cyanide Total (ug/L)

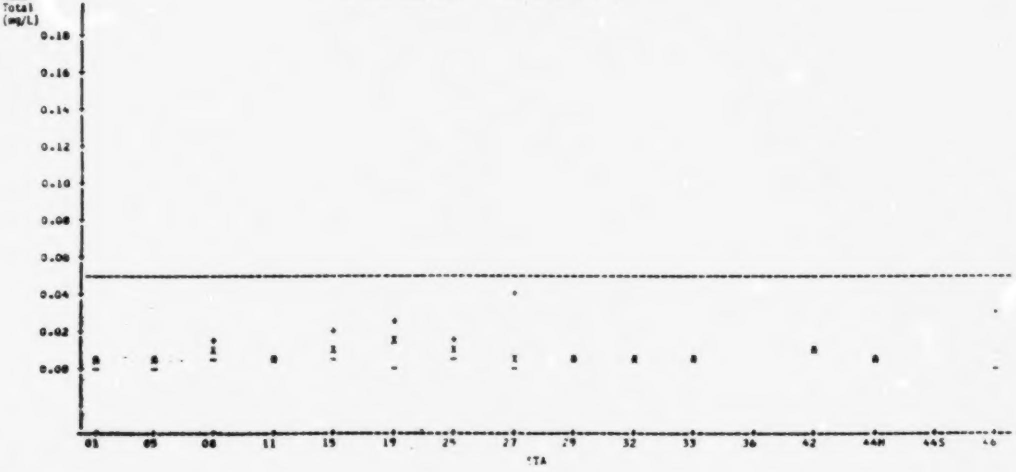
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 8:11 WEDNESDAY, NOVEMBER 14, 1984 25
WINTER SEASON
Table A7.38 Lead Total (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

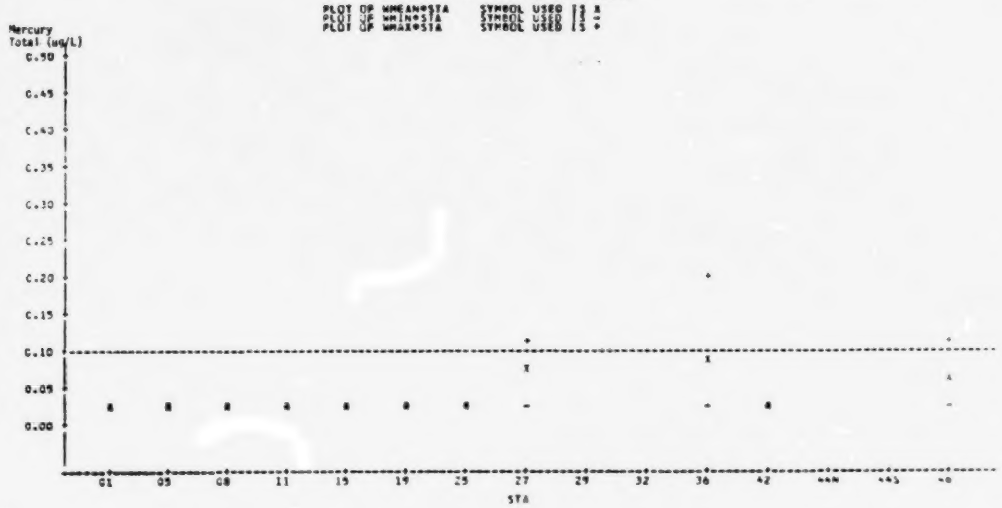


N. SASK R. 1970-1982 8:11 WEDNESDAY, NOVEMBER 14, 1984 26
SUMMER SEASON
Table A7.38 Lead Total (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



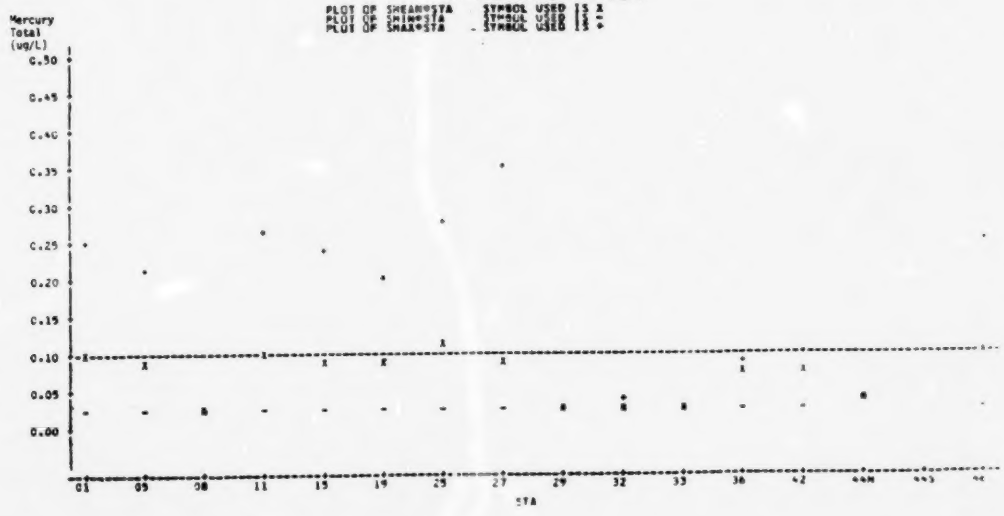
N. SASK R. 1970-1982 12159 THURSDAY, NOVEMBER 15, 1984 1
WINTER SEASON
Table A7.34 Mercury Total (ug/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 12159 THURSDAY, NOVEMBER 15, 1984
SUMMER SEASON
Table A7.35 Mercury Total (ug/L)

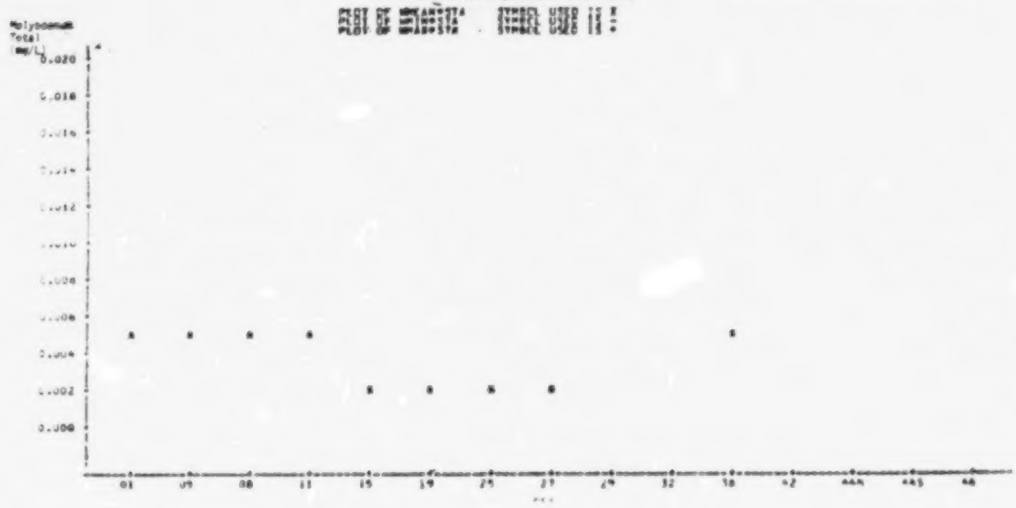
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.38 Molybdenum Total (mg/L)

15:31 THURSDAY, NOVEMBER 15, 1984 1

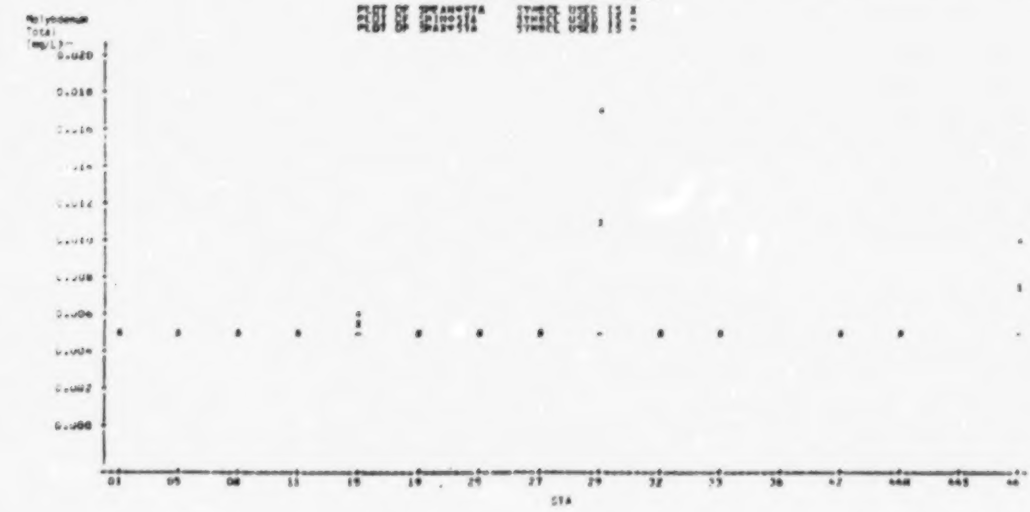
PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +

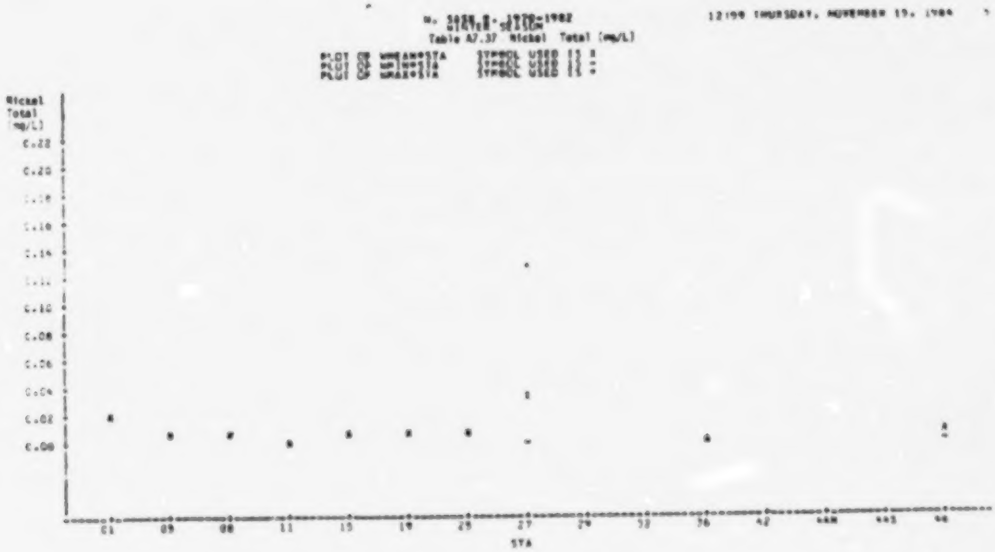


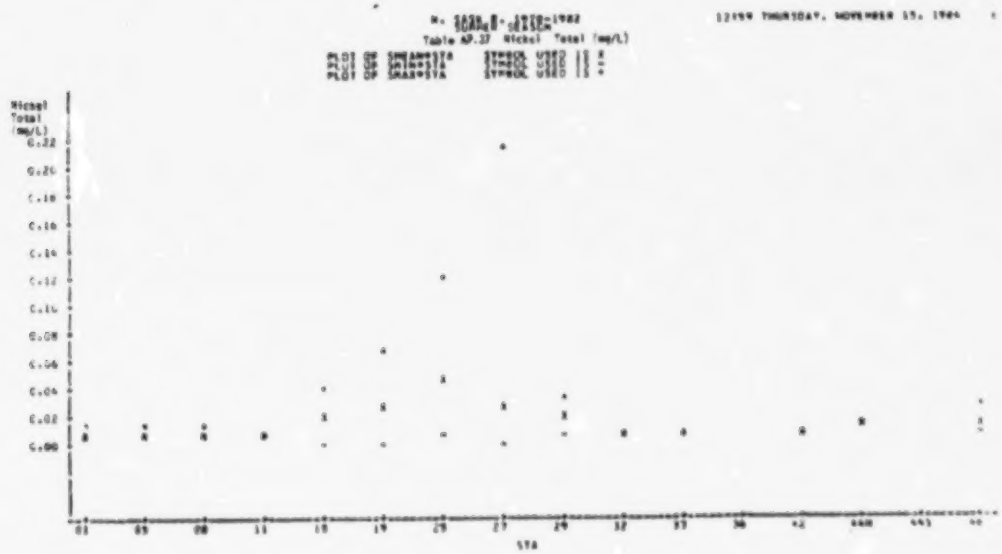
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.38 Molybdenum Total (mg/L)

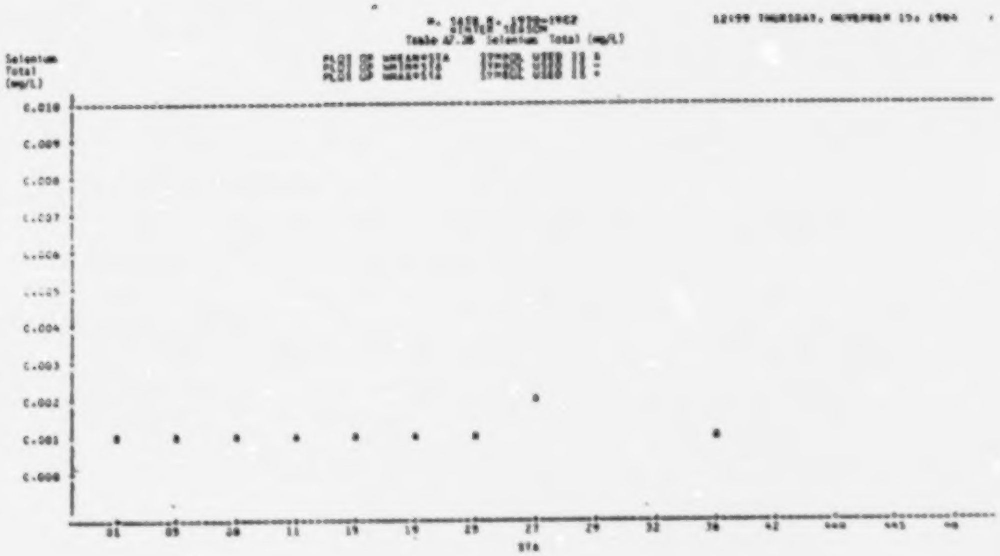
15:31 THURSDAY, NOVEMBER 15, 1984 2

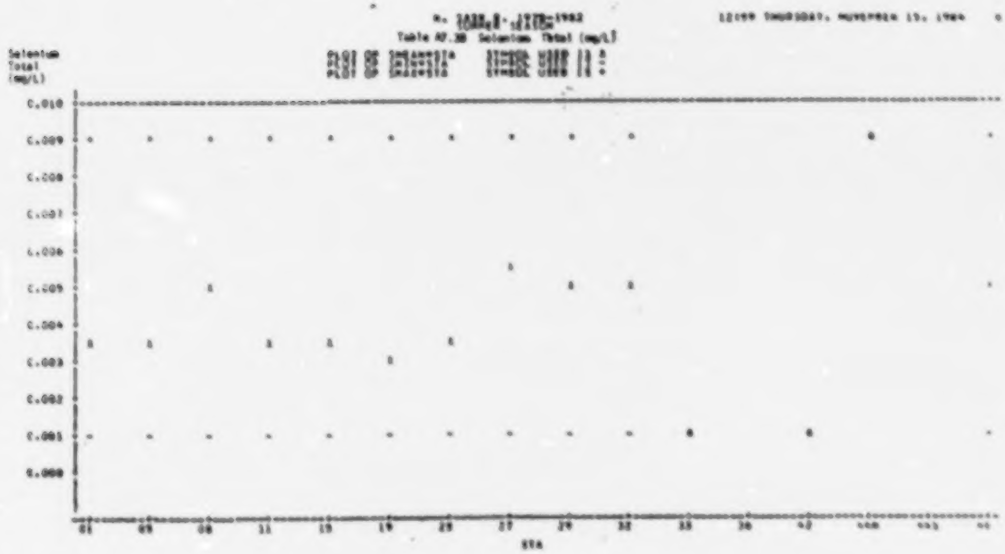
PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +




12:59 THURSDAY, NOVEMBER 15, 1984
Table A7.37 Nickel Total (mg/L)
PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +
Nickel Total (mg/L)
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
01
05
08
11
15
19
25
27
29
32
36
42
44A
44S
46
STA


12:59 THURSDAY, NOVEMBER 15, 1984
Table A7.37 Nickel Total (mg/L)
PLOT OF MEAN*STA SYMBOL USED IS X
PLOT OF MIN*STA SYMBOL USED IS -
PLOT OF MAX*STA SYMBOL USED IS +
Nickel Total (mg/L)
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
01
05
08
11
15
19
25
27
29
32
37
38
42
44A
44S
46
STA

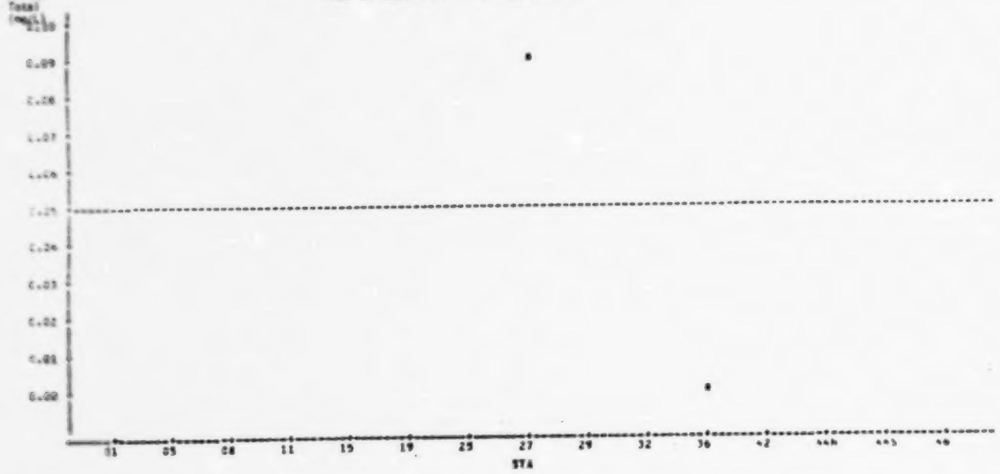

THURSDAY, NOVEMBER 15, 1984
Table A7.3B Selenium Total (mg/L)
Selenium
Total
(mg/L)
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
01
05
08
11
15
19
25
27
29
32
36
42
STA


THURSDAY, NOVEMBER 15, 1984
Table A7.3B Selenium Total (mg/L)
Selenium
Total
(mg/L)
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
01
05
08
11
15
19
25
27
29
32
35
36
42
STA

N. SASK R. 1970-1982
WINTER SEASON
Table A7.39 Silver Total (mg/L)

12:59 THURSDAY, NOVEMBER 15, 1984

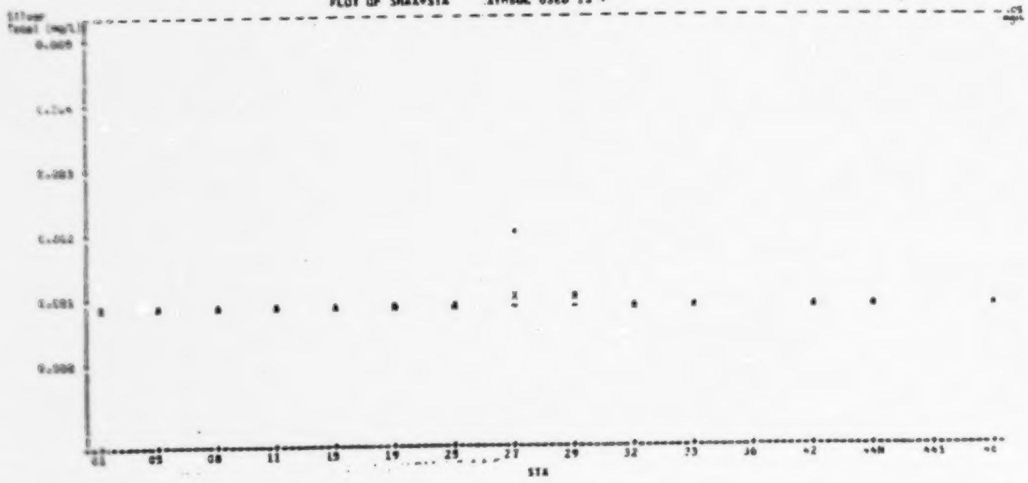
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.39 Silver Total (mg/L)

12:59 THURSDAY, NOVEMBER 15, 1984

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK.R.-1970-1982 12:59 THURSDAY, NOVEMBER 15, 1984 11

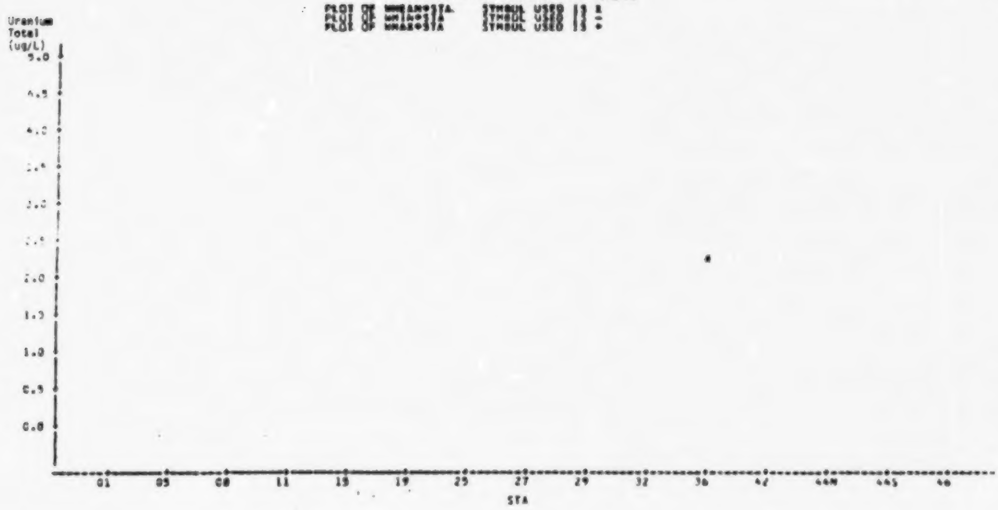
WINTER SEASON

Table A7.40 Uranium Total (ug/L)

PLOT OF WMEAN*STA SYMBOL USED IS X

PLOT OF WMIN*STA SYMBOL USED IS -

PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK.R.-1970-1982 12:59 THURSDAY, NOVEMBER 15, 1984 12

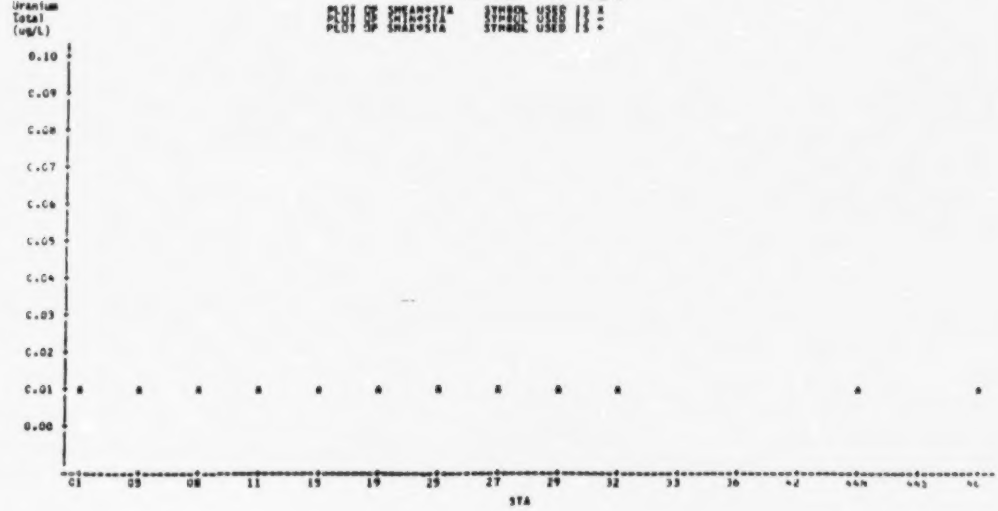
SUMMER SEASON

Table A7.40 Uranium Total (ug/L)

PLOT OF SMEAN*STA SYMBOL USED IS X

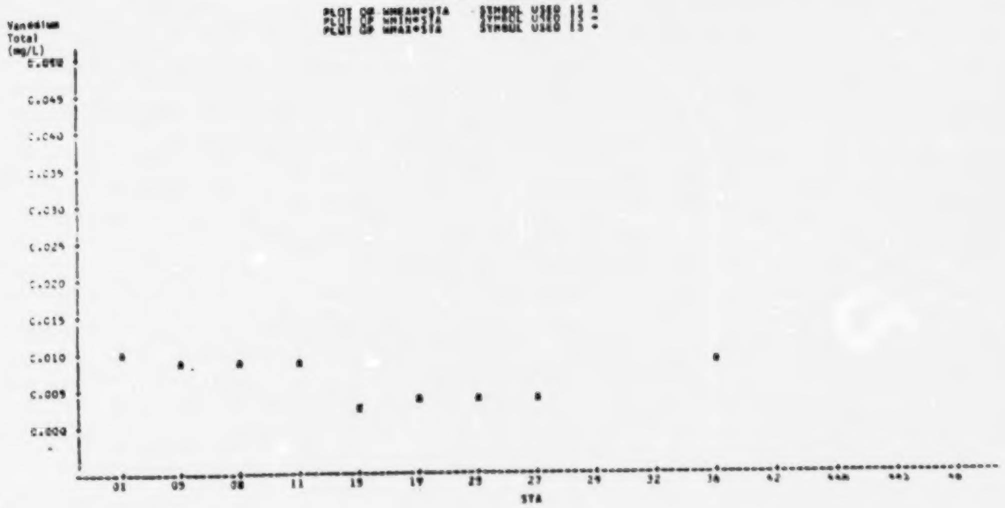
PLOT OF SMIN*STA SYMBOL USED IS -

PLOT OF SMAX*STA SYMBOL USED IS +



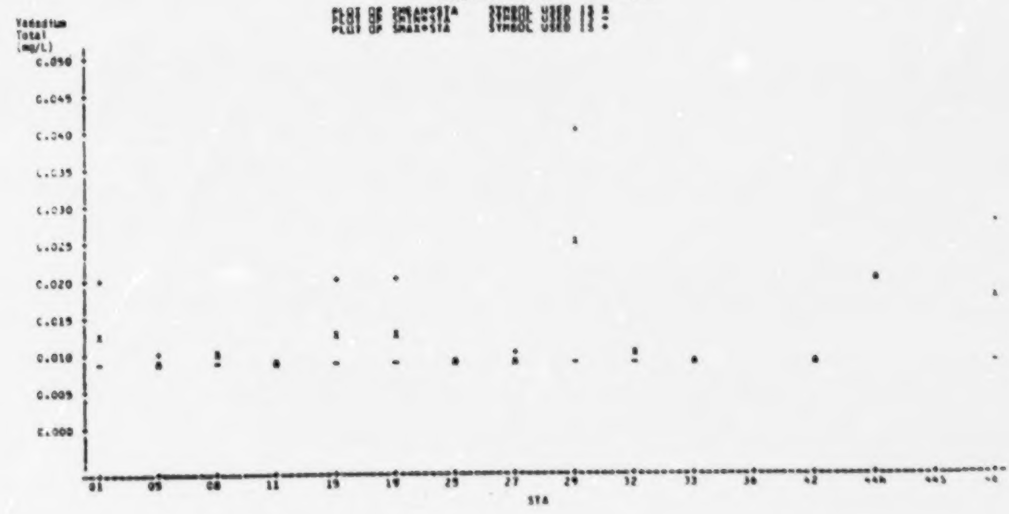
N. SASK R. 1970-1982
WINTER SEASON
Table A7.41 Vanadium Total (mg/L)

PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



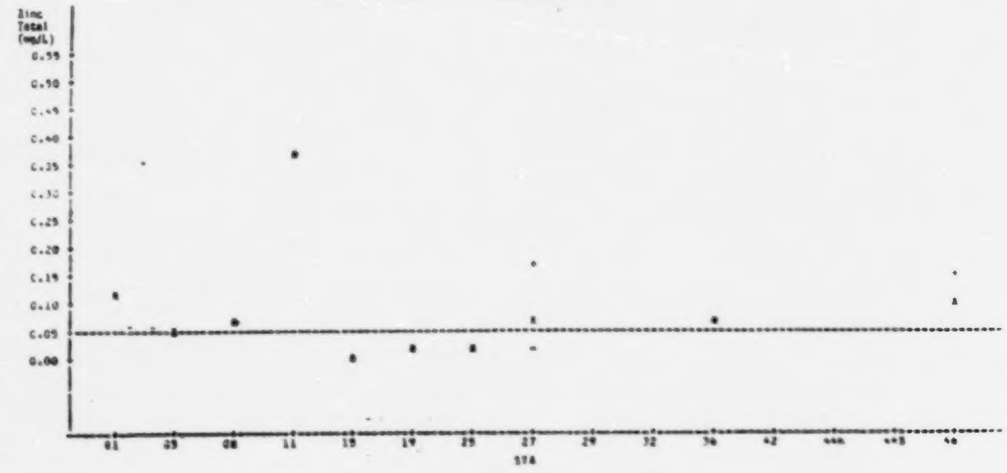
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.41 Vanadium Total (mg/L)

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



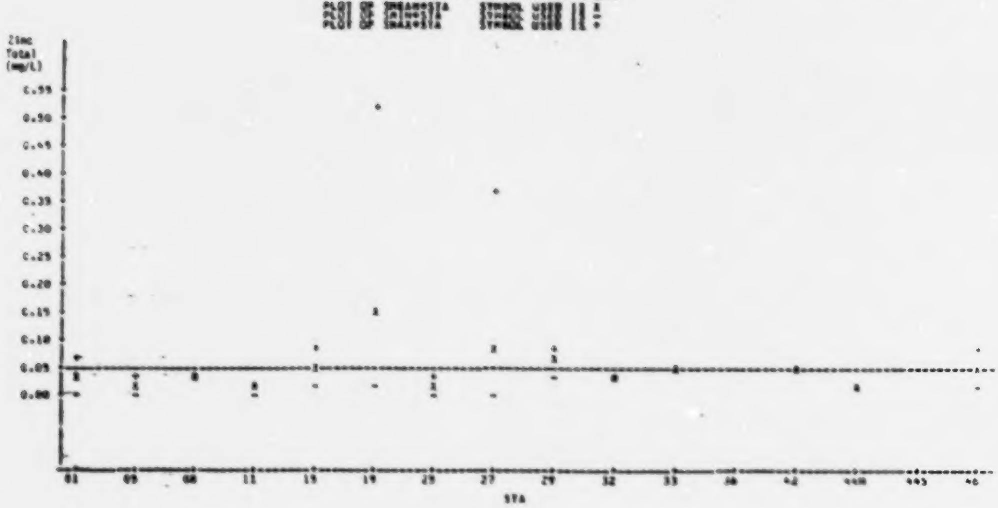
[illegible] 12:59 THURSDAY, NOVEMBER 15, 1984 15

Table A7.42 Zinc Total (mg/L)



[illegible] 12:59 THURSDAY, NOVEMBER 15, 1984 16

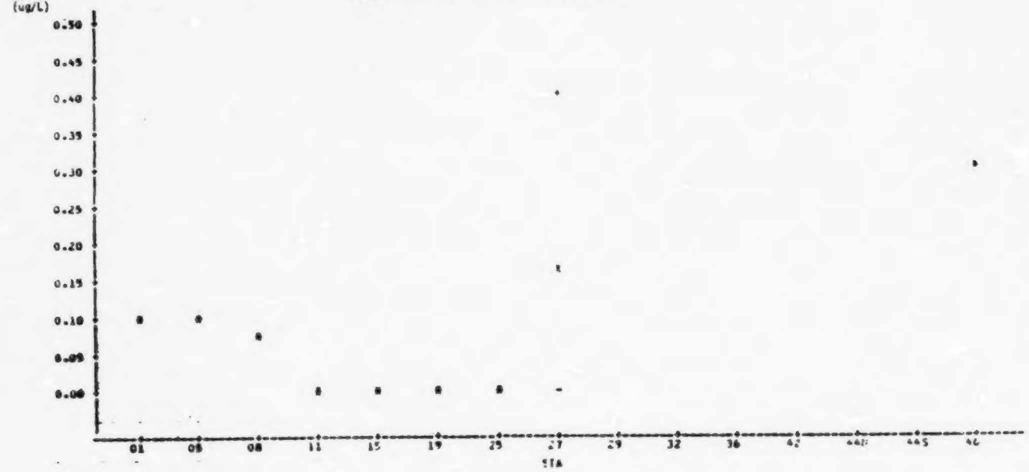
Table A8.42 Zinc Total (mg/L)



N. SASK R. 1970-1982
WINTER SEASON
Table A7.43 2,4-D (ug/L)

9:11 WEDNESDAY, NOVEMBER 14, 1984

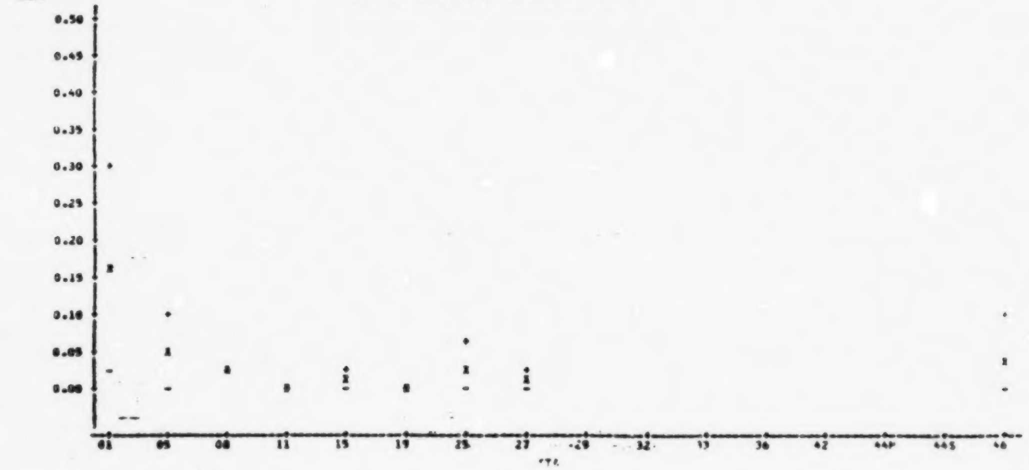
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.43 2,4-D (ug/L)

9:11 WEDNESDAY, NOVEMBER 14, 1984

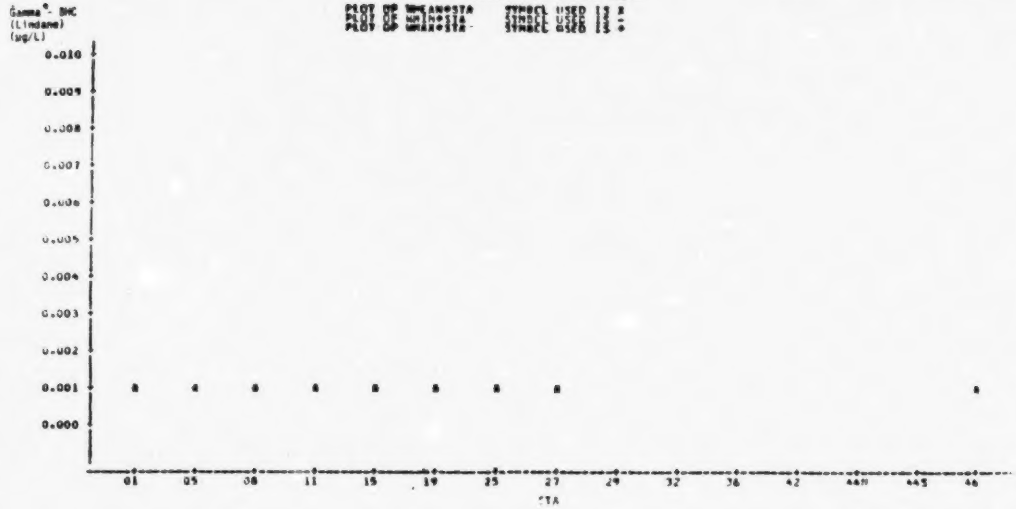
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982 11:11 WEDNESDAY, NOVEMBER 14, 1984

WINTER SEASON

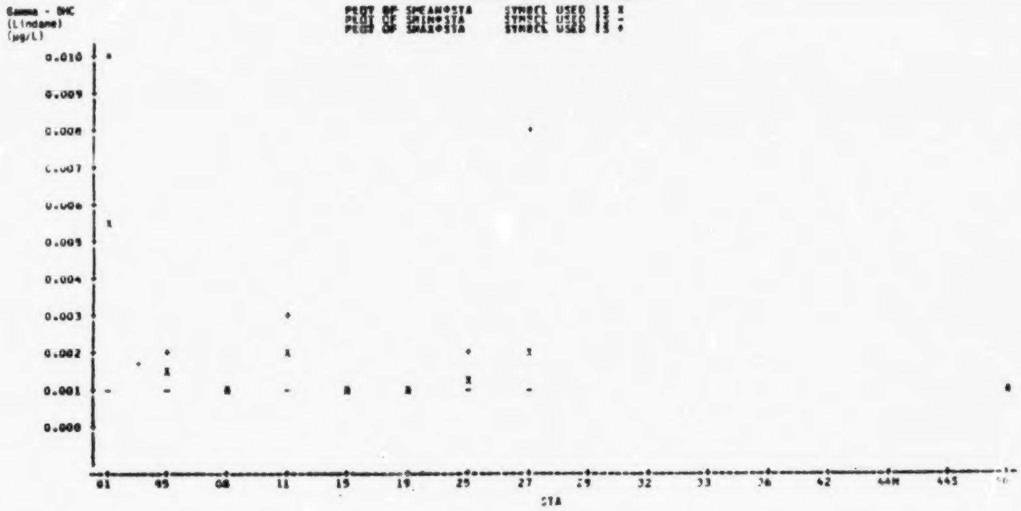
Table A7.44 Gamma - BHC (Lindane) (µg/L)



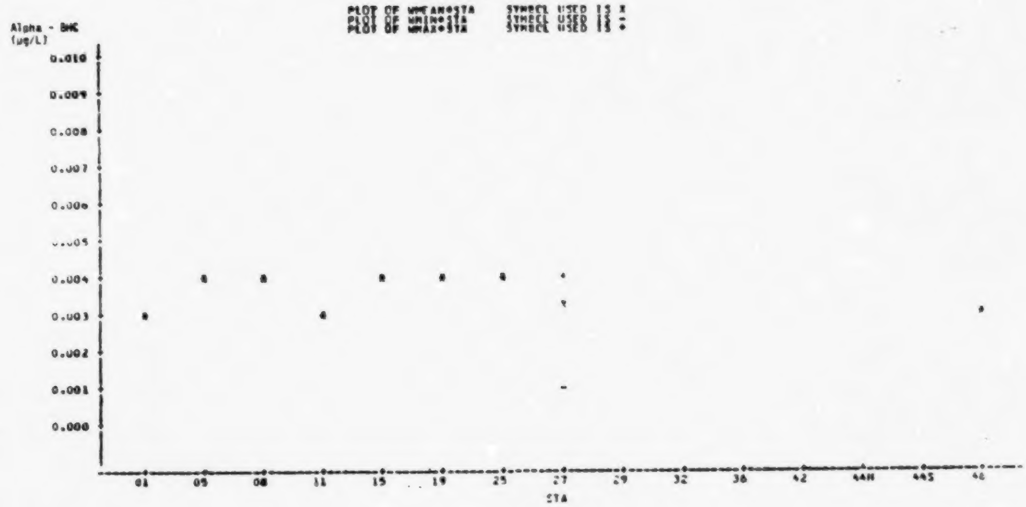
N. SASK R. 1970-1982 11:11 WEDNESDAY, NOVEMBER 14, 1984

SUMMER SEASON

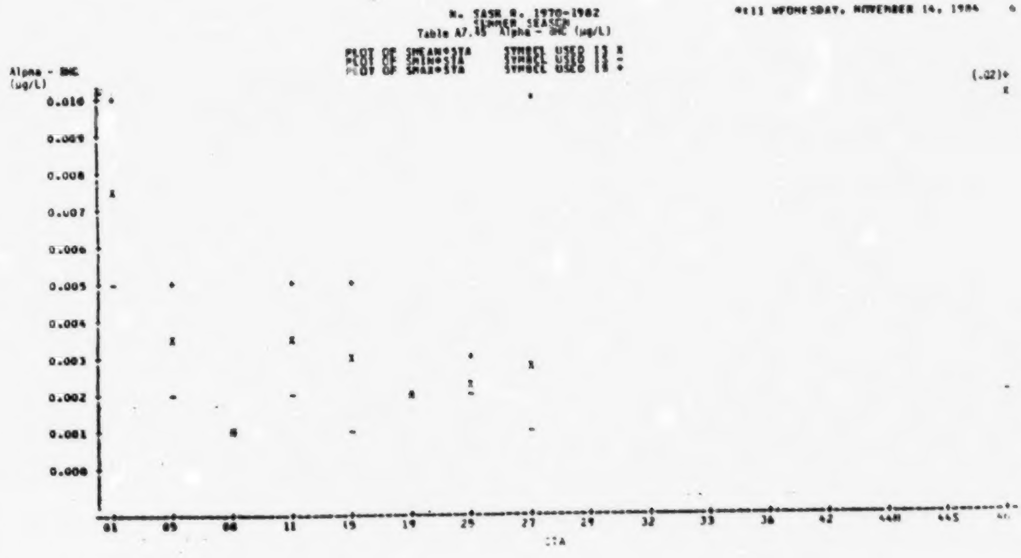
Table A7.44 Gamma - BHC (Lindane) (µg/L)



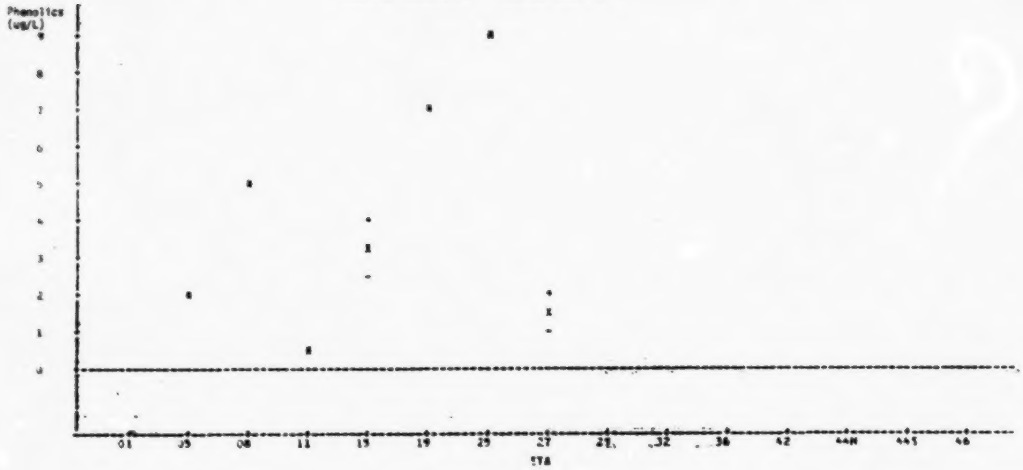
N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984 5
WINTER SEASON
Table A7.45 Alpha - BHC (µg/L)



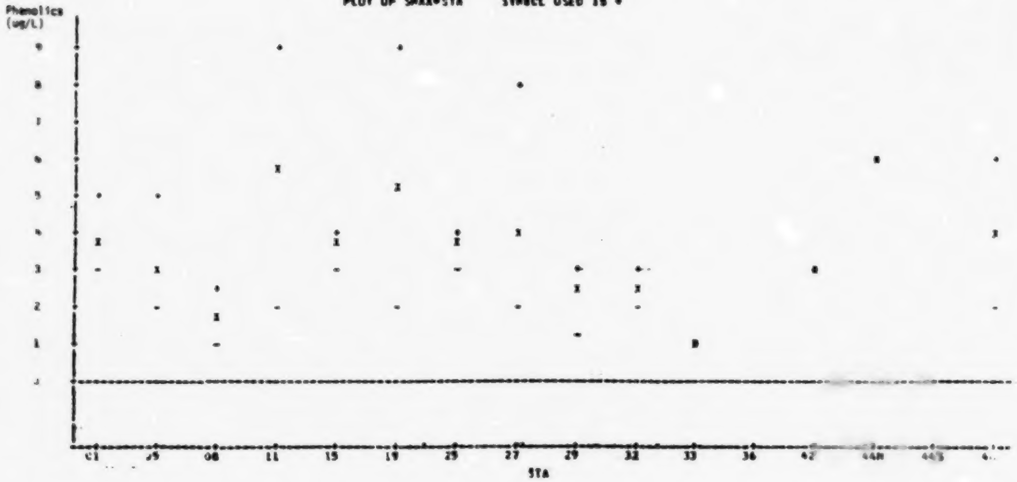
N. SASK R. 1970-1982 9:11 WEDNESDAY, NOVEMBER 14, 1984 6
SUMMER SEASON
Table A7.45 Alpha - BHC (µg/L)



N. SASK R. 1970-1982
WINTER SEASON
Table.A7.46 Phenolics (ug/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



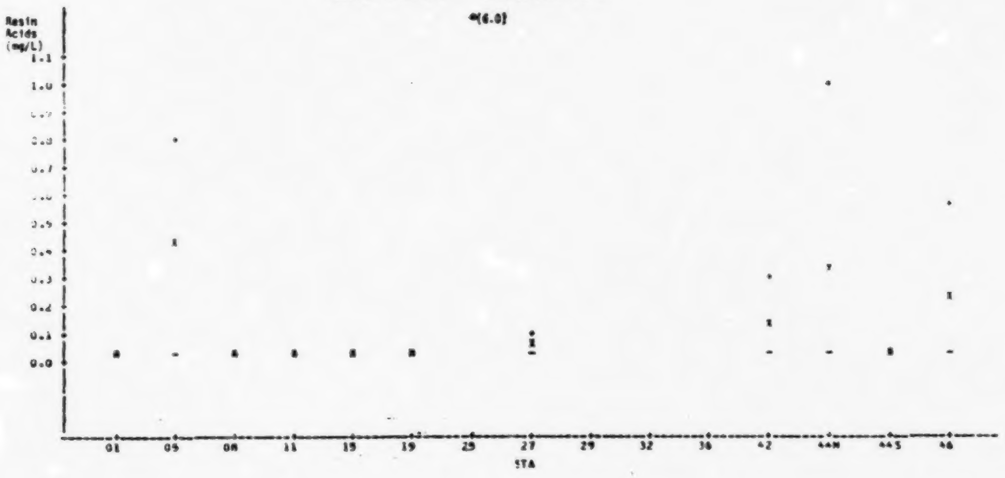
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.46 Phenolics (ug/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
WINTER SEASON
Table A7.47 Resin Acids (mg/L)

15:31 THURSDAY, NOVEMBER 15, 1984 3

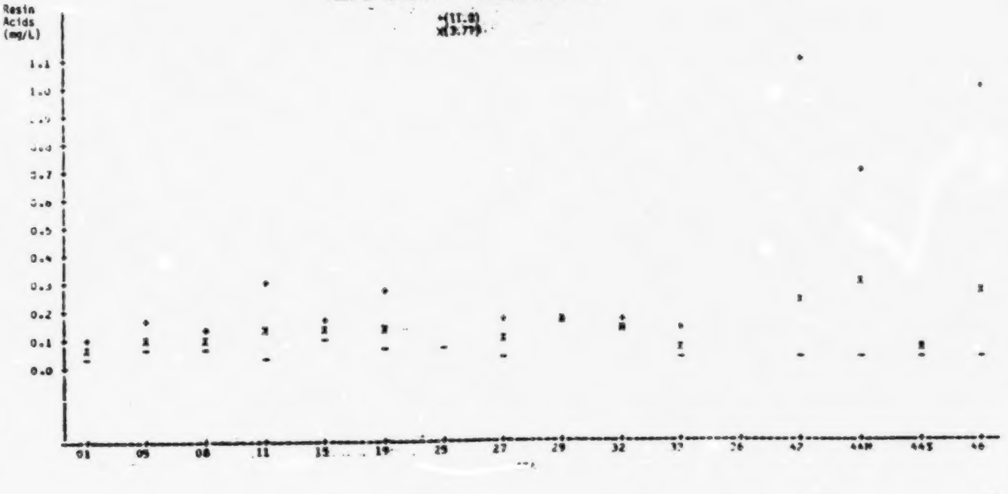
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +



N. SASK R. 1970-1982
SUMMER SEASON
Table A7.47 Resin Acids (mg/L)

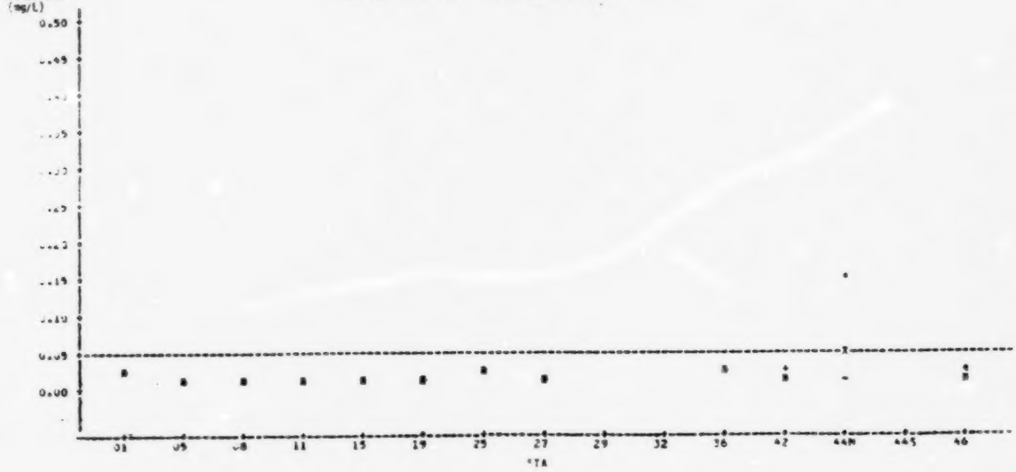
15:31 THURSDAY, NOVEMBER 15, 1984 4

PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +



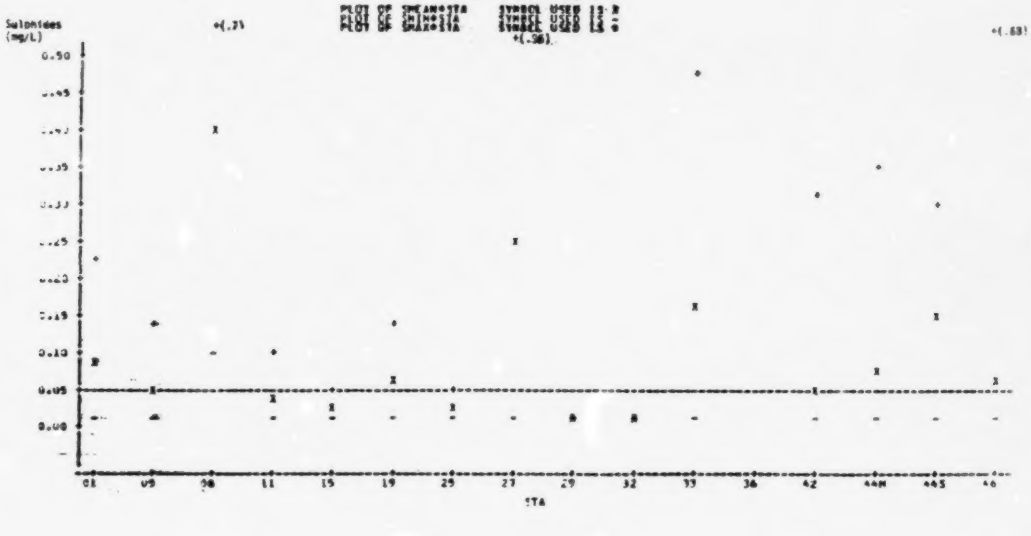
N. SASK R. 1970-1982
WINTER SEASON
Table A7.48 Sulphides (mg/L)
PLOT OF WMEAN*STA SYMBOL USED IS X
PLOT OF WMIN*STA SYMBOL USED IS -
PLOT OF WMAX*STA SYMBOL USED IS +

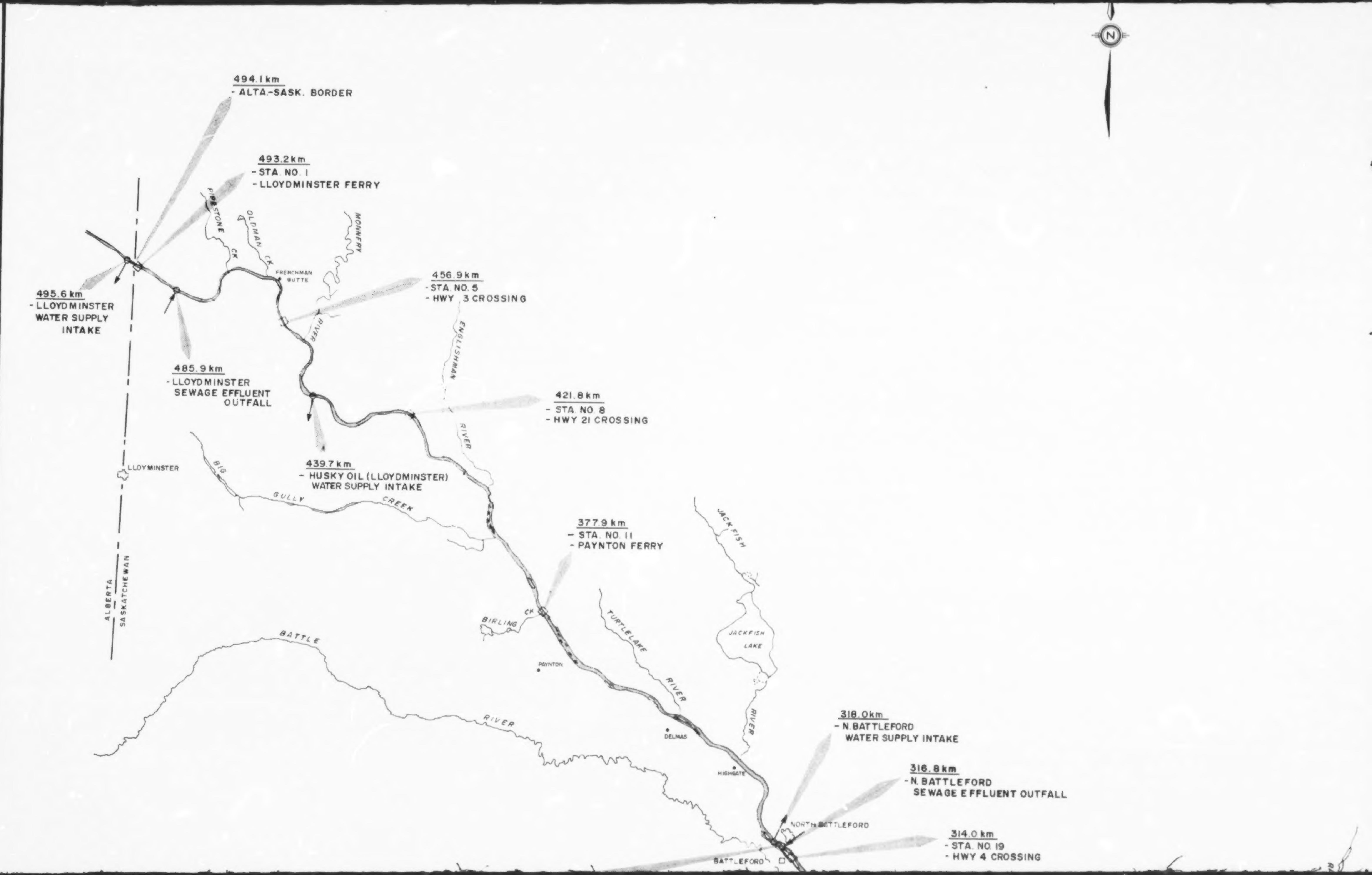
11:48 MONDAY, NOVEMBER 5, 1984 22

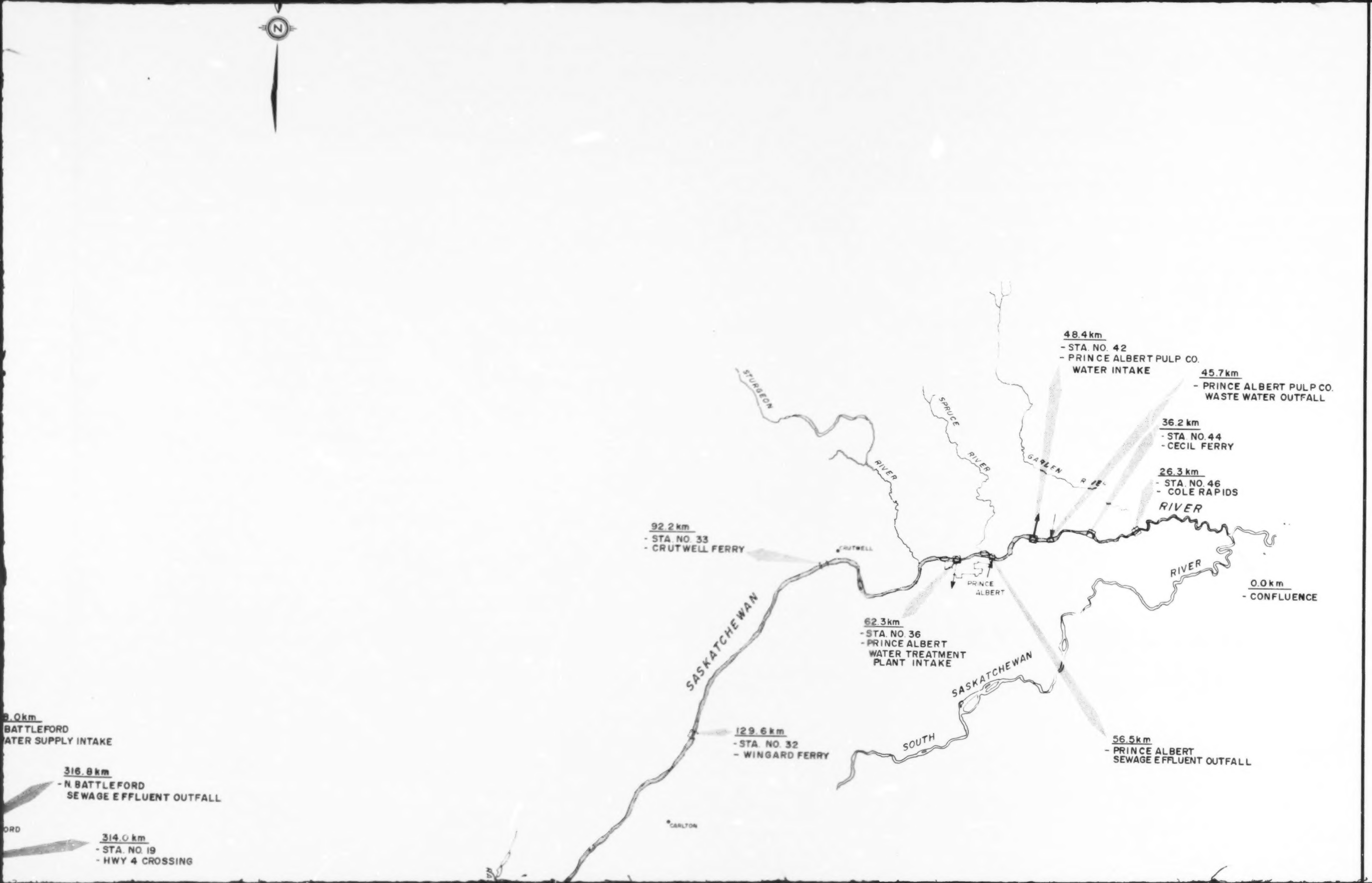


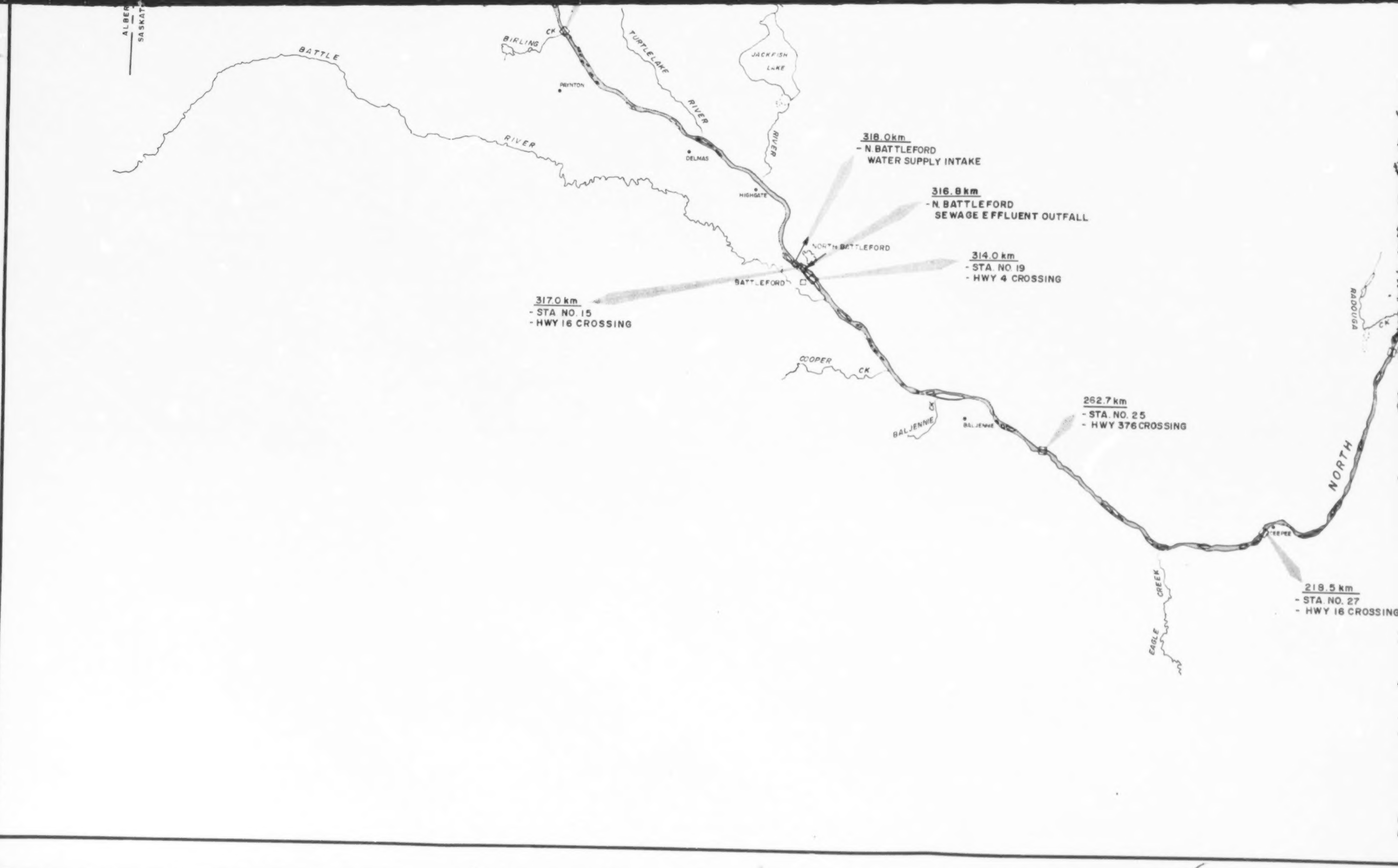
N. SASK R. 1970-1982
SUMMER SEASON
Table A7.48 Sulphides (mg/L)
PLOT OF SMEAN*STA SYMBOL USED IS X
PLOT OF SMIN*STA SYMBOL USED IS -
PLOT OF SMAX*STA SYMBOL USED IS +

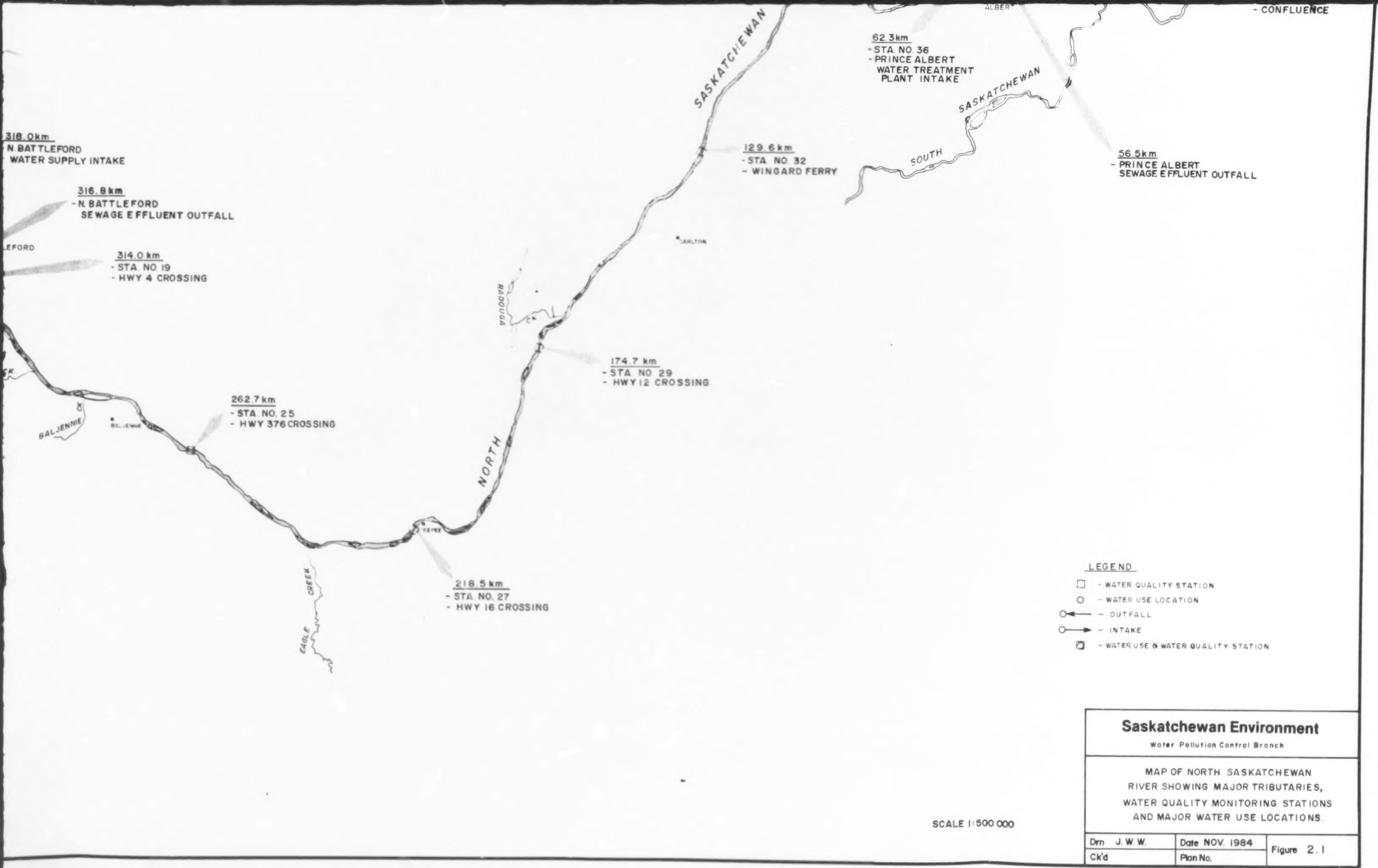
11:48 MONDAY, NOVEMBER 5, 1984 23




N
494.1 km
- ALTA.-SASK. BORDER
493.2 km
- STA. NO. 1
- LLOYDMINSTER FERRY
495.6 km
- LLOYDMINSTER
WATER SUPPLY
INTAKE
485.9 km
- LLOYDMINSTER
SEWAGE EFFLUENT
OUTFALL
PIPESTONE CK
OLDMAN CK
MONNERY
FRENCHMAN BUTTE
RIVER
456.9 km
- STA. NO. 5
- HWY 3 CROSSING
ENGLISHMAN RIVER
421.8 km
- STA. NO. 8
- HWY 21 CROSSING
439.7 km
- HUSKY OIL (LLOYDMINSTER)
WATER SUPPLY INTAKE
LLOYMINSTER
BIG GULLY CREEK
377.9 km
- STA. NO. 11
- PAYNTON FERRY
JACKFISH
JACKFISH LAKE
TURTLELAKE RIVER
BIRLING CK
PAYNTON
ALBERTA
SASKATCHEWAN
BATTLE RIVER
DELMAS
RIVER
HIGHGATE
318.0 km
- N. BATTLEFORD
WATER SUPPLY INTAKE
316.8 km
- N. BATTLEFORD
SEWAGE EFFLUENT OUTFALL
NORTH BATTLEFORD
314.0 km
- STA. NO. 19
- HWY 4 CROSSING
BATTLEFORD


N
48.4km
- STA. NO. 42
- PRINCE ALBERT PULP CO.
WATER INTAKE
45.7km
- PRINCE ALBERT PULP CO.
WASTE WATER OUTFALL
36.2 km
- STA. NO. 44
- CECIL FERRY
26.3 km
- STA. NO. 46
- COLE RAPIDS
STURGEON
RIVER
SPRUCE
RIVER
GARDEN RIVER
RIVER
92.2 km
- STA. NO. 33
- CRUTWELL FERRY
CRUTWELL
PRINCE
ALBERT
RIVER
0.0 km
- CONFLUENCE
62.3km
- STA. NO. 36
- PRINCE ALBERT
WATER TREATMENT
PLANT INTAKE
SASKATCHEWAN
SASKATCHEWAN
SOUTH
.0km
BATTLEFORD
ATER SUPPLY INTAKE
129.6 km
- STA. NO. 32
- WINGARD FERRY
56.5km
- PRINCE ALBERT
SEWAGE EFFLUENT OUTFALL
316.8km
- N. BATTLEFORD
SEWAGE EFFLUENT OUTFALL
CARLTON
ORD
314.0 km
- STA. NO. 19
- HWY 4 CROSSING


ALBER
SASKAT
BIRLING CK
PAYNTON
BATTLE RIVER
TURTLELAKE RIVER
JACKFISH LAKE
RIVER
DELMAS
HIGHGATE
318.0km
- N. BATTLEFORD WATER SUPPLY INTAKE
316.8km
- N. BATTLEFORD SEWAGE EFFLUENT OUTFALL
NORTH BATTLEFORD
314.0 km
- STA. NO. 19
- HWY 4 CROSSING
BATTLEFORD
317.0 km
- STA NO. 15
- HWY 16 CROSSING
COOPER CK
BALJENNIE CK
BALJENNIE
262.7 km
- STA. NO. 25
- HWY 376 CROSSING
RADOUGA CK
NORTH
TEEPEE
EAGLE CREEK
218.5 km
- STA. NO. 27
- HWY 16 CROSSING


CONFLUENCE
ALBERT
62.3km
- STA. NO. 36
- PRINCE ALBERT
WATER TREATMENT
PLANT INTAKE
SASKATCHEWAN
SOUTH
SASKATCHEWAN
56.5km
- PRINCE ALBERT
SEWAGE EFFLUENT OUTFALL
SASKATCHEWAN
129.6km
- STA. NO. 32
- WINGARD FERRY
CARLTON
318.0km
- N. BATTLEFORD
- WATER SUPPLY INTAKE
316.8km
- N. BATTLEFORD
SEWAGE EFFLUENT OUTFALL
LEFORD
314.0km
- STA. NO 19
- HWY 4 CROSSING
RADOUGA
CK
174.7km
- STA. NO 29
- HWY 12 CROSSING
262.7km
- STA. NO. 25
- HWY 376 CROSSING
BALJENNIE
BALJENNIE
CK
NORTH
218.5km
- STA. NO. 27
- HWY 16 CROSSING
EAGLE CREEK
LEGEND
☐ - WATER QUALITY STATION
○ - WATER USE LOCATION
○← - OUTFALL
○→ - INTAKE
▣ - WATER USE & WATER QUALITY STATION
SCALE 1:500 000

Saskatchewan Environment

Water Pollution Control Branch

MAP OF NORTH SASKATCHEWAN
RIVER SHOWING MAJOR TRIBUTARIES,
WATER QUALITY MONITORING STATIONS
AND MAJOR WATER USE LOCATIONS.

Drn J. W. W.	Date NOV. 1984	Figure 2.1
Ck'd	Plan No.	

POOR
QUALITY
ORIGINAL